United States
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Animal and
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In Cooperation with

USDA's
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and

United States
Department of the
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Bureau of
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April 1994

Animal Damage Control Program

Final Environmental Impact Statement

Appendix P

Risk Assessment of Wildlife Damage Control Methods Used by the USDA Animal Damage Control Program

Appendix Q

USEPA-Approved Registrations for Pesticides Used in the APHIS Animal Damage Control Program

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Risk Assessment of Wildlife Damage Control Methods Used by the USDA APHIS Animal Damage Control Program

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A. Introduction and Summary

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control program (ADC) is a Federal/cooperative program that upon request provides services to other Federal, State, and private organizations to support a nationwide program of research, direct control, and technical assistance to control wildlife damage. The APHIS ADC program uses chemical and nonchemical methods to control a variety of wildlife damage problems. This Appendix provides a comprehensive overview of the potential risks to nontarget animals, APHIS ADC employees, and the public that may result from the use of these methods. The focus is on chemical and nonchemical methods used in direct control of wildlife damage. Many of the methods used in direct control are also recommended through technical assistance for use by persons outside the APHIS ADC program. All of the wildlife damage control methods used by the APHIS ADC program during FY 1988 are addressed. In addition, chemical methods used during the period 1989 through 1991 are also addressed. Measures that will be used by APHIS ADC to manage or mitigate the risks associated with the use of wildlife damage control methods are identified.

The National Environmental Policy Act (NEPA) requires that Federal agencies must assess the potential environmental impacts of any major Federal action and consider such impacts in its decisionmaking. This appendix furthers the goals of NEPA by describing the risks of APHIS ADC's wildlife damage control methods. This information, together with the impact assessment in Chapter 4, will be considered by APHIS in selecting an appropriate programmatic alternative to meet the Congressional mandate for wildlife damage control.

1. Project Description

APHIS ADC implements a nationwide program of wildlife damage control based on the Integrated Pest Management (IPM) approach described in Chapter 2 and Appendix N. The APHIS ADC program was transferred from the U.S. Department of the Interior (USDI), U.S. Fish and Wildlife Service (USFWS), to the USDA Animal and Plant Health Inspection Service (APHIS) in 1986. In 1990, APHIS issued a programmatic Draft Environmental Impact Statement (DEIS) for the APHIS ADC program. The DEIS discussed the physical and chemical characteristics and environmental behavior of chemicals used by APHIS ADC for vertebrate pest control, as well as typical uses of nonchemical control methods. The DEIS did not include a formal assessment of the potential risks of APHIS ADC control methods to nontarget animals, APHIS ADC employees, or the public.

Comments on the DEIS requested further information about APHIS ADC's wildlife damage control methods and their potential effects. To respond to these comments, APHIS ADC has provided additional information about (1) the process used to select methods for use by APHIS ADC employees or to develop recommendations for technical assistance (see Chapter 2 and Appendix N), and (2) about the environmental impacts of these methods (see Chapter 4). APHIS ADC has also conducted a comprehensive assessment of the risks associated with the program's use of nonchemical and chemical methods, which is reported in this appendix. This assessment focuses on the risks of APHIS ADC control methods as implemented on a nationwide basis rather than on site-specific projects conducted by APHIS ADC. This emphasis reflects the programmatic approach adopted for this final EIS. The comments received from the public, Federal and State agencies, and private organizations have made an important contribution to defining the issues addressed in this appendix.

P Appendix

a. Contents of this Appendix

This Appendix consists of the following sections:

- The first section describes the risk assessment process in general terms. This includes a discussion of the basic components of risk assessment and their application to the APHIS ADC program, a summary of the major findings concerning potential risks of APHIS ADC control methods, and the mitigation measures that APHIS ADC will use to reduce these risks.
- The second section evaluates risks to nontarget animals, APHIS ADC employees, and the public that are associated with use of each APHIS ADC nonchemical control method.
- The third section assesses the risks to nontarget animals, APHIS ADC employees, and the public associated with use of each APHIS ADC chemical control method.

Readers who wish to gain an understanding of the basic approach and major findings of this assessment can do so by reading the first section. The subsequent two sections provide technical discussions of the methods and findings.

B. Overview of Risk Assessment

The APHIS ADC program's Integrated Pest Management (IPM) approach includes non-chemical and chemical control methods that are appropriate for many different kinds of wildlife damage problems. Selection of an appropriate method can help to avoid or minimize potential adverse environmental impacts (see the discussion of the process used to select appropriate methods in Chapter 2). Along with effectiveness, cost, and social acceptability, risk is an important criterion for selection of an appropriate method. Determination of potential risks to nontarget animals, APHIS ADC employees, and the public that could be associated with the use of each APHIS ADC wildlife damage control method is thus an important prerequisite for successful application of the IPM approach. This section describes the general approach to risk assessment used in this appendix and summarizes the findings of the assessment.

1. Risk and Risk Assessment

If "risk" is defined as the chance of suffering harm, "risk assessment" refers to methods of analysis used to determine the chance of suffering a specific kind of harm. There are many such methods currently in use to analyze many different kinds of risk situations. All methods are derived from basic concepts of risk assessment. These components include the following:

- An analysis of the hazardous or dangerous features of the subject of the risk assessment. This analysis is sometimes called a "hazard assessment." With respect to APHIS ADC control methods, this analysis includes examination of the toxicological properties of APHIS ADC chemicals and the hazardous features of nonchemical control methods. If the hazard analysis indicates that a particular method does not possess any hazardous features, then there may be no risk or only low risk associated with its use.
- An analysis of the likelihood, duration, and frequency of being exposed to the hazard. This is often referred to as an "exposure assessment." With respect to APHIS ADC control methods, this analysis includes examination of the patterns of use to determine the likelihood that nontarget animals or human beings will be exposed to the method's dangers. If this analysis shows that such exposure will not occur, then there may be no risk or only low risk associated with the method.

- A determination of the resulting risk. This involves making a determination of the chance of suffering harm, given the dangerous features of the method and the likelihood of exposure. With respect to APHIS ADC control methods, determinations of risk sometimes involve qualitative assessments and sometimes involve complex modeling and statistical analysis of situations representing different combinations of hazard and exposure.

2. Assessing Risks of APHIS ADC Control Methods

The general approach to risk assessment outlined above consists of three steps:

- Identify potentially hazardous features
- Analyze potential exposure to these hazardous features
- Determine the resulting risk.

Application of this general approach to the APHIS ADC program was a complex undertaking. Several factors were taken into account in deciding how to apply the generic approach to risk assessment and to the control methods used by the APHIS ADC program.

The variety of control methods and circumstances in which they may be used presents difficulties in selecting a typical or representative set of circumstances that could be used as the basis for the assessment. APHIS ADC's IPM approach consists of three "action approaches": resource management, physical exclusion, and wildlife management (see Chapter 2 and Appendix J). Resource management methods manipulate resources or habitat to reduce the likelihood of wildlife damage. Examples of these methods include animal husbandry practices such as herding and shed lambing and modifications to buildings to make them less attractive to wildlife or less vulnerable to wildlife damage. Physical exclusion methods exclude predators or other wildlife from access to valued resources. The primary exclusion method is fencing. Wildlife management methods move or remove the offending animal from the setting and so reduce wildlife damage. Examples include the use of such frightening devices as propane cannons or chemical repellents, or such lethal methods as traps or chemical toxicants. The APHIS ADC program is a national program, and control methods are used in many different circumstances and habitats. Resource management, physical exclusion, and some wildlife management methods are normally recommended by APHIS ADC and implemented by the resource owner. Many wildlife management methods are normally implemented by APHIS ADC personnel.

In assessing the risk of wildlife damage control methods, several factors related to the pattern of use for each method can affect potential exposure and, thus, the risk associated with each method. The physical characteristics of many control devices inherently exclude the possibility of effects to species that are too large or too light to fit into or trigger the devices. Small cage traps cannot accommodate large animals. Small animals are not heavy enough to trigger some cage traps or leghold traps equipped with underpan tension devices. Also, fences that effectively exclude large animals such as deer may not present an impediment to smaller species.

Method placement patterns as influenced by the presence or absence of nontarget animals and the public affects the likelihood of nontarget or human exposures. Placement of conibear traps in aquatic environments limits the exposure of these devices to aquatic species. Placement of leghold traps in areas of limited human access and the posting of warning signs greatly reduce the likelihood of human exposures.

Season of use affects the likelihood of exposure to both nontarget species and humans because of migratory patterns and seasonal variations in abundance of some wildlife species and seasonal variations in the level of human outdoor recreational activities. Species that

migrate are not at risk when control methods are placed in their absence. Control methods placed away from wildlife populations that concentrate around water sources during the summer minimizes exposure to nontargets. Restricting control method placements during hunting seasons or other seasons of heavy recreational activity limits human exposures.

In conjunction with seasons of use, the duration and concentration of control device placements affects the potential for exposures. M-44 use restrictions limit the density of device placement. Additionally, placements are restricted to times when losses are occurring or can be reasonably expected to occur. Most chemical methods have similar application rate restrictions and preexisting condition requirements.

APHIS ADC *Directives* contain numerous method-specific constraints that provide protection to nontargets and humans. These constraints represent the standard operating procedures (SOPs) that have been identified and adopted by the APHIS ADC program over time to ensure the greatest feasible degree of selectivity and safety for all control efforts. Examples include use of warning signs, certification requirements, underpan tension devices for leghold traps, and trap placement restrictions around animal carcasses used as draw stations.

Chemical registrations contain extensive provisions to ensure their safe application. These provisions restrict application in the ranges of threatened and endangered species, provide protection for aquatic systems when contamination concerns are present, require certification of applicators when appropriate, prescribe efficacious application rates, specify proper disposal procedures, and the like.

Additionally, the Biological Opinion issued by the U.S. Department of Interior, U.S. Fish and Wildlife Service, (USFWS) contains numerous species-specific protections in the form of reasonable and prudent measures and alternatives to protect federally listed threatened and endangered species (see Appendix F).

In addition to the variety of control methods and their potential applications, existing risk assessment methodology is more applicable to some damage control tools than others. For some control methods, there are well-established scientific approaches, technical procedures, and guidance for assessing risks. In other cases, there is little guidance. For example, there are established risk assessment models and statistical procedures for analyzing some of the chemicals used by APHIS ADC. There is no established technique for assessing the potential risks of building fences to exclude wildlife from croplands. In general, established risk assessment procedures are more useful for analyzing chemical than non-chemical damage control methods.

There is also variability in the availability of data that can be used in risk assessment. APHIS ADC records provide good information regarding amounts of chemicals used in direct control activities. Records of injuries to APHIS ADC employees are also available, although the level of detail varies. APHIS ADC records the number of target and nontarget animals taken by each of its lethal control methods (see Appendix H). However, there is very little published information regarding risks to nontarget wildlife of fencing, animal husbandry methods, or architectural design.

Finally, some control methods, especially lethal ones, used by APHIS ADC are more controversial than others or have more obvious hazards associated with them. Such control methods as leghold traps, shooting, or the use of some chemicals have been and will continue to be the object of scrutiny.

Consideration of these factors led to implementation of the following general plan for risk assessment:

- The risk assessment addressed environmental and human health and safety risk. Environmental risk was defined primarily in terms of risks to nontarget animals. Human health and safety risks were defined in terms of risks to APHIS ADC

employees and the public. Because the exposure of the public is minimal, the analysis focused on risks to workers. If risks to workers are low, then risks to the public should be even lower.

- Qualitative risk assessments of resource management and physical exclusion methods were conducted. This decision to use qualitative assessment reflects the state of risk assessment approaches and the availability of data. It also reflects the fact that many resource management and physical exclusion methods are less controversial than wildlife management methods. Accordingly, qualitative assessments of such control methods as fencing, habitat management, animal husbandry, and the use of lure crops are included in this appendix. Risks to nontarget animals, APHIS ADC employees, and the public were rated as low, moderate, or high, based on an analysis of the method and known features of its use.
- Where risk assessment methods and data permitted, appropriate quantitative risk assessments of wildlife management methods were conducted. Accordingly, quantitative assessments of the risks of such lethal control methods as trapping, shooting, and chemical use are included in this appendix.
- Quantitative assessments of nonchemical methods were based on an analysis of data from six western states: Arizona, California, New Mexico, Oklahoma, Texas, and Utah. The APHIS ADC Management Information System (MIS) was operational in these states in 1988, and the data are more extensive and consistent than in other areas. These six states also accounted for approximately 60 percent of the program's use of many nonchemical methods.
- Quantitative assessments of chemical methods were conducted in stepwise fashion to focus on the chemicals with the highest level of potential risk. Initial screening was conducted to identify chemicals with no or little risk. For those chemicals requiring further analysis, detailed quantitative assessment focused on "representative scenarios" incorporating features likely to lead to the greatest exposure (and thus the greatest potential risk) to nontarget animals. Use of this procedure resulted in methods with greatest potential risk receiving the most analysis.

3. Summary of Findings: Nonchemical Methods

As already noted, the IPM approach includes many different methods for responding to wildlife damage problems. Table P-1 lists the methods evaluated, along with the results of the evaluation. Complete descriptions of each method are provided in this detailed risk assessment and in Appendix J.

a. Evaluation Procedure

Evaluation of risks associated with use of nonchemical control methods proceeded in three steps, as follows:

- A use profile for each method was developed. The use profile described the typical uses of each method in the APHIS ADC program, based on information provided by APHIS ADC State Directors and other sources. The use profile identified resources protected, target and nontarget species affected, and other important information.
- Potential hazards associated with each method were identified, based on analysis of the method. Hazards included such factors as the likelihood that use of the method would result in human injury or injury or death to nontarget animals.

- Risks associated with each method were evaluated. For resource management, physical exclusion, and some wildlife management methods, risks were evaluated qualitatively. Based on analysis of the use profile and potential hazards of each method, risks were categorized as low, moderate, or high (Table P-1). For the remaining wildlife management control methods, risks were evaluated quantitatively, as follows:
  - Risks to nontarget animals (referred to in the analysis as environmental risks), were based on the percentage of nontarget animals captured or killed by each method. This measure allows a conservative interpretation of potential risk because many nontarget animals captured by APHIS ADC control methods are released. These percentages are given in Table P-1. As already noted, the percentages were computed using data in the APHIS ADC MIS, which provides the most extensive records of such data.
  - Risks to APHIS ADC employees were based on APHIS health and safety records. Where possible, reported injuries were associated with an employee's use of a specific control method, based on information submitted by the employee. For this analysis, a "serious injury" was defined as any injury that required the employee to take time off from work. This is a conservative concept of "serious injury."
  - Risks to the public were based on analysis of reports submitted by APHIS ADC State Directors.

b. Findings

As shown in Table P-1, the environmental and human health and safety risks associated with resource management methods are low. There are several reasons for these findings. APHIS ADC resource management methods are variations of farming, ranching, or construction practices. Use of APHIS ADC methods does not add to the risks already present in these occupations. Many resource management methods, such as elimination of wildlife feeding or alteration of aircraft flight patterns to avoid potential wildlife obstacles, reduce risk to human populations. Finally, since resource management methods are often implemented at little or no risk to workers or the public, these are low-risk methods.

Similarly, the use of physical exclusion methods typically poses low risk to the environment and to human health and safety. Use of these methods may involve loss or restriction of habitat to some nontarget species and minor injuries to individuals who build physical barriers; however, these features do not constitute serious risks.

Of the nonchemical wildlife management methods used by APHIS ADC, leghold traps and neck snares pose the highest risks to nontarget species. Overall, approximately 23 percent and 18 percent of animals captured in leghold traps and snares, respectively, were nontarget animals. The other nonchemical wildlife management methods appear to pose substantially lower levels of risk. These methods include habitat management, the use of lure crops and alternate foods, frightening devices, cage traps, quick-kill traps, aerial hunting, shooting, and egg and nest removal.

APHIS ADC has implemented a variety of program directives to reduce potential risks associated with the use of wildlife damage control methods (see Mitigation: APHIS ADC directives on page P-10). For example, extreme care is taken to avoid airplane and firearm malfunctions that could lead to accidental injury or death. Only certified pilots may engage in aerial hunting. The analysis presented here represents the level of risk to human health and safety after taking these policies into account.

Using the very conservative criterion of time away from work as the measure of serious injury, examination of APHIS injury records showed that the risks to APHIS ADC employees are low. The total number of reported injuries reported for the six representative

Table P-1

Risks of Nonchemical Methods Used or Recommended by the APHIS ADC Program

Method	Environmental Risk	Human Health Risk
Resource Management		
Animal husbandry	Low	Low
Crop selection	Low	Low
Habitat management	Low	Low
Modification of human behavior	Low	Low
Physical Exclusion		
Fencing, barriers, and others	Low	Low
Wildlife Management		
Habitat management	Low	Low
Lure crops/alternate foods	Low	Low
Frightening devices	Low/Moderate	Low
Kill or relocation methods		
Leghold traps	23 %[a]	Low
Cage traps	1.2 %	Low
Snares	18 %	Low
Quick kill traps	4.6 %	Low
Aerial hunting	0	Low
Shooting	0.04 %	Low
Egg and nest removal	0	Low

[a] Quantitative environmental risk stated as nontarget animals captured as a percent of total captures.

States was only 21, and only 5 appear to be associated with the use of control methods. Most of the injuries are associated with office work or with the characteristics of outdoor work in general.

APHIS ADC records reflect no injuries to the public resulting from the use of nonchemical control methods by APHIS ADC personnel in FY 88. The health risk to the public is low because most APHIS ADC nonchemical methods are used in areas where public access is limited. Additionally, for those methods that might pose risks to the public, warning signs are posted to alert the public that the devices are present.

4. Summary of Findings: Chemical Methods

a. Evaluation Procedure

The importance of chemical methods in the overall APHIS ADC program mandates adopting a quantifiable, widely accepted approach to evaluating potential impacts of using pesticides to manage vertebrate pests. Such an approach is quantitative risk assessment. It is currently used in responding to diverse regulations in order to quantify potential impacts

of exposure to pesticides or other chemical compounds. The risk assessment employed for this analysis was based on a widely used, generally accepted paradigm (NAS 1983). In addition, because the focus was ecological risk assessment in particular, the analysis also incorporated the Federal guidance provided by Barnthouse et al. (1986), the USEPA Office of Pesticide Programs (USEPA 1986e), the USEPA Risk Assessment Forum (USEPA 1992aa), and other widely accepted sources.

The risk assessment examined potential adverse effects associated with exposure to any of the chemical pesticide compounds used nationwide for direct control of vertebrates by APHIS ADC during the fiscal years 1988 through 1991. The assessment emphasized potential effects to wildlife, in particular those designated under the Endangered Species Act of 1973, as amended. It also addressed potential effects to wildlife or communities not included under the Endangered Species Act. The risk assessment also considered potentially exposed human beings, such as in recreation (e.g., hunters and hikers), residential areas (e.g., local residents), or particular occupations (e.g., pest control operators). Such workers, ostensibly the single most exposed group, are protected by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Occupational Safety and Health Act.

Product labels played a key role in the analysis because of the express FIFRA provisions forbidding the use of a pesticide "in a manner inconsistent with its labeling." Accordingly, restricted-use pesticides were addressed differently from those active ingredients for which only an experimental use permit had been issued. Where no label restrictions were established, however, the risk assessment addressed the potential for impacts to occur under label-specified application and use-pattern scenarios.

The risk assessment procedure consisted of eight general steps:

- Defining the complete list of available chemical methods, including those used for both technical assistance and direct control.
- Separating those materials used for only technical assistance from those used for direct control by the program.
- Collecting key information, including use pattern, potential nontarget receptors, and compound-specific environmental fate and toxicological properties;
- Using this information to screen compounds (i.e., designating them as *no probable risk compounds* or *compounds requiring quantitative risk assessment*).
- Conducting quantitative risk assessment.
- Analyzing each compound for off-site transport potential (minimal or significant), including defining key potential pathways and receptors.
- Conducting quantitative exposure assessment and risk characterization for those compounds found to have significant off-site transport potential.
- Using these findings to form the basis for deriving conclusions and recommending mitigation measures for the compounds determined to pose potential risks.

b. Findings

Thirty-nine formulated products were considered for the risk assessment. Of these, 12 were designated as *no probable risk*, based on critical element screening, numerical screening, or the quantitative risk assessment itself. This conclusion suggests if label specifications are followed and use patterns continued as in the past, no adverse effects are expected for any of these products. The 12 formulated products were:

- Alpha-chloralose
- DRC-1339 (Gull Toxicant), 98 percent

- DRC-1339, 98 percent, egg and meat bait
- Mineral oil
- Glyphosate (Rodeo), 53.8 percent
- Compound PA-14 (Tergitol), 99.5 percent
- Polybutene (Eaton's 4-the-Birds)
- Brodifacoum (Weather Blok), 0.005 percent
- Cholecalciferol (Quintox), 0.075 percent
- Zinc phosphide, 63 percent concentrate for rat control
- Bone tar oil (Magic Circle Deer Repellent), 93.75 percent
- Tranquilizers/euthanizing agents.

The remaining 27 formulated products were designated as posing "probable risk" based on the quantitative risk assessment. These 27 formulated products were:

- 4-aminopyridine (Avitrol), 0.5 percent
- 4-aminopyridine (Avitrol), 25 percent
- DRC-1339, 98 percent, feedlots
- DRC-1339, 98 percent, structures
- DRC-1339, 98 percent, staging areas
- DRC-1339 (Starlicide Complete), 0.1 percent
- Fenthion (Rid-A-Bird), 11 percent
- Fenthion (BCF#1), 9 percent
- Strychnine, pigeon corn bait
- Strychnine, bird toxicant
- Strychnine, sparrow-cracks
- Aluminum phosphide, 55 percent or 57 percent
- Sodium nitrate (gas cartridge for rodents), 43.36 percent
- Strychnine, SRO, 0.5 percent
- Strychnine, milo, 0.35 percent
- Strychnine, 1.6 percent, paste
- Strychnine, 4.9 percent, paste
- Strychnine, 5.79 percent, salt block
- Zinc phosphide concentrate for mouse control, 63 percent
- Zinc phosphide concentrate for muskrat control, 63 percent
- Zinc phosphide on steam-rolled oats, 2 percent
- Zinc phosphide (Rodent Bait AG), 2 percent
- Zinc phosphide (D&H Formula Rodent Rid-R), 2 percent
- Zinc phosphide on wheat, 1.82 percent
- Sodium cyanide (M-44 Cyanide Capsules), 88.62 percent

- Sodium fluoroacetate (Compound 1080)
- Sodium nitrate (gas cartridges for coyotes).

Of these 27 formulated products, only the eight strychnine formulations were designated as posing probable risks based on secondary exposure. No compounds were designated as posing probable risks based on either soil or surface water exposure.

If the recommended mitigation measures are followed and use patterns continued as in the past, no adverse effects are expected for any of the above formulated products.

5. Mitigation: APHIS ADC Directives

APHIS ADC program personnel have long been aware, even without a comprehensive risk assessment, that use of wildlife damage control methods entails potential risks to nontarget species and workers. Accordingly, program managers have attempted to reduce the degree of risk by regulating factors that influence risk. These factors include the patterns of use of the method, the characteristics of the method itself, and the training and experience of the applicator. APHIS ADC Directives, which serve as programwide guidance, prescribe training or certification for the use of specific methods (such as aerial hunting), identify personnel authorized to use specific methods, or provide guidance for the use of specific control methods. The recommendation or use of nonchemical control methods is conducted in accordance with APHIS ADC Directives established to ensure human health and safety and protection of the environment. Relevant Directives for this assessment include but are not limited to the following:

- APHIS ADC Aviation Safety and Operations
- Explosives Use and Safety
- Firearm Use and Safety
- Lure Crop Use
- Traps and Trapping Devices
- Scents, Baits, and Attracting Devices
- Hunting, Trailing, or Decoy Dog Use

Implementation of these Directives is an important mitigation measure. The evaluation of risks to the environment and human health and safety posed by nonchemical methods takes these Directives into account.

a. Additional Mitigation Measures

The APHIS ADC Directives identify a variety of mitigation measures currently employed as SOPs in the APHIS ADC program. This risk assessment identifies additional measures which may be adopted to further mitigate potential risks associated with specific methods.

(1) Nonchemical Methods

With respect to nonchemical methods, the highest risks are associated with the use of leghold traps and snares. APHIS ADC now requires the use of pan-tension devices in leghold traps. These devices reduce the chance that nontarget animals will be caught inadvertently in leghold traps. APHIS ADC has also adopted the reasonable and prudent alternatives concerning nonchemical methods that were identified in the USFWS Biological Opinion (Appendix F). Adoption of these provisions will ensure that significant adverse impacts to federally designated threatened and endangered species do not occur. Finally, as noted in Chapter 5, APHIS ADC will monitor its activities so that potential adverse impacts can be identified and mitigated.

(2) Chemical Methods

Risk assessment results indicate that additional mitigation measures (label specifications) may be appropriate to avoid potential nontarget effects. The purpose of this section is to make such recommendations as presented by specific pesticide formulation in Table P-30.

A key assumption for making these recommendations is that if a product is designated "no probable risk" based on the risk assessment, no mitigation is required either because of inherently low nontarget hazard (i.e., risk) or because of adequate protection afforded by pesticide labels.

In some cases mitigation measures are expected to virtually preclude nontarget effects if pursued carefully, while in other instances these measures may reduce but not eliminate such exposures.

It appears that primary exposure represents the key source of potential nontarget hazards for products potentially causing nontarget effects. For example, many of the potentially hazardous exposures identified in the risk assessment involve primary ingestion of bait by nontarget animals. Appropriate mitigation in such cases would include prebaiting and observing the site for the presence of potentially susceptible nontarget species. Another potentially important mitigation measure is that poison baits and carcasses be removed immediately after desired control is obtained. Accordingly, while already included for many of the product labels, these simple measures could be recommended for products where this mode of exposure is potentially significant and where labels are not sufficiently protective. These include 4-aminopyridine (lacks picking up carcasses); DRC-1339, 98 percent (lacks picking up bait or carcasses for some labels); strychnine grain baits for rodents (lacks bait pick-up); strychnine paste (lacks bait and carcass pick-up), and various zinc phosphide formulations (except muskrat control, oats, D&H, and ZP rodent bait).

The Avitrol (0.5 percent) label specifies that uneaten bait be removed from the site of application by the end of the day; it is therefore unnecessary to recommend this measure. Such a measure is also believed unnecessary for DRC-1339 (eggs and meat bait) because primary hazards are not expected to cause major concern to representative avian and mammalian indicators (HQ values of less than one).

Products that were subjected to Qualitative Risk Assessment (QRA) analysis for on-site exposures only, including sodium nitrate and aluminum phosphide, are relatively easy to mitigate because burrows can be investigated for the presence of susceptible nontarget species and product control is less complex. Although numerous restrictions have been issued relating to application of sodium cyanide, this product is difficult to mitigate because of the unique mode of application and the difficulties associated with controlling potential nontarget exposure.

Evidence of elevated adverse effects was identified for Fenthion (Rid-A-Bird), 9 percent and 11 percent solutions (acute dermal exposure only); strychnine steam-rolled oats, 0.5 percent, strychnine milo, 0.35 percent, strychnine pastes, 1.6 and 4.9 percent (acute primary oral exposure only); and zinc phosphide baits, 1.8 - 2.0 percent (chronic primary oral exposure only). It would be difficult to mitigate against such exposures, however, because of the unique modes of application and the difficulties associated with controlling all potential exposures.

Strychnine was the only compound for which secondary hazards were found to be significant. Secondary hazards for raptors associated with strychnine were identified with respect to application of all above- and below-ground formulated products. To mitigate such a potential risk to raptors, it is recommended that remains of the target animal be removed from the area of strychnine application as soon as possible. Some of the strychnine labels specify such measures, while others do not, as stated previously.

Specific restrictions on pesticide use are recommended to protect potentially affected T&E (or other nontarget) species for each of the potential "probable risk" formulations, where such restrictions are not already included on the label. These restrictions could be included on the label or instituted through an agency-wide policy. If the mitigation measures specified are carefully followed for both nonlisted and listed species, the potential for nontarget effects is expected to be materially reduced.

C. Risk Assessment for APHIS ADC Nonchemical Control Methods

1. Introduction

This risk assessment provides an analysis of the risks to nontarget animals, workers, and the public posed by nonchemical methods which may be used by APHIS ADC. A comprehensive listing of wildlife damage control methods used or recommended by APHIS ADC is included in Chapter 2 (Table 2-4). For descriptions of these methods, see Appendix J.

Wildlife damage control methods may be grouped according to three action approaches: resource management, physical exclusion, and wildlife management. A listing of nonchemical methods used in direct control by the APHIS ADC program in 1988 is provided in Table P-2.

2. Risk Assessment Procedure

For each nonchemical method, the potential risks to employees, the public, and nontarget species were characterized in either qualitative or quantitative terms. Qualitative characterizations of potential risks were developed for resource management, physical exclusion, and some resource management methods. These methods are largely recommended by APHIS ADC (technical assistance) and implemented by resource owners or managers. Initial review of the methods suggested that they did not pose risks requiring quantitative analysis. In qualitative terms, risks to the environment or to human health and safety are characterized as "low," "moderate," or "high." However, because many of the remaining wildlife management methods may result in injury or death to nontarget species or may result in injury to humans (especially APHIS ADC employees), a quantitative analysis of these methods was appropriate.

The quantitative analyses were based on data compiled for the six States that used APHIS ADC's MIS in 1988: Arizona, California, New Mexico, Oklahoma, Texas, and Utah. The MIS provided the most extensive and consistent data base of information about target and nontarget take and the most relevant information for assessing environmental risk. Although other States used nonchemical methods, these six states accounted for the largest proportion of use of many controversial nonchemical methods (such as trapping). The measure of environmental risk for each of these methods was the number of nontarget animals captured as a percentage of the number of captures. This measure was chosen because it is a conservative measure. Many animals captured by APHIS ADC are released unharmed. The proportion of such animals released varies by method. Because many animals are released, potential risk may be overestimated.

Assessment of potential risks to APHIS ADC workers was based on data compiled from injuries reported to the APHIS Health and Safety Office. These reports were supplemented by records from APHIS ADC State Offices to ensure that non-Federal APHIS ADC employee

injuries were included. The reported injuries were in some cases associated with the use of specific control methods. When reporting an injury, APHIS ADC employees provide information about the injury and the circumstances that led to it. This information was used to identify serious injuries and associate them, where possible, with the method used

Table P-2

Nonchemical Methods Used in Direct Control by the Animal Damage Control Program During FY 1988

Method	State	Resources Protected	Target Species
Resource Management			
Guarding dogs	NY, WA	Livestock	Coyote
Physical Exclusion			
Fencing (electric)	GA, NH, NY	Human health & safety, beehives, buildings, livestock, poultry, trees, domestic pets.	Black bear, deer, moose, coyote, dog
Netting	TN, WA	Human health & safety, shellfish, utilites.	Canada goose, duck, pigeon
Other barriers	TX	Agricultural land.	
Wildlife Management			
Habitat Management			
Water manipulation	GA	Timber, highways, agricultural lands.	Beaver
Dam removal (explosives)	GA, KY, MI, NC, TN, WI	Timber, highways, agricultural lands.	Beaver
Lure crops	TN	Human health & safety.	Canada goose
Frightening Devices			
Electronic harassment devices	GA, KY, OH, TN, WV, HI, NM, ND, WA	Urban buildings/roost sites, health & safety, livestock, fisheries, aviation, utilities.	Blackbird, starling, myna, coyote, heron, crane, gull, crow, turkey, vulture, dove, goose.
Propane exploders	GA, KY, MI, MN, OH, AK, AZ, CO, HI, ID, NE, NM, ND, OK, OR, SD, WA, TN, VT	Farm ponds, livestock, grain crops, orchards, urban buildings/roost sites, human health & safety.	Coyote, starling, heron, robin, blackbird, mannikin, plover, bulbul, gull, gray wolf, goose, duck, turkey vulture, crow, deer, swan, tern, merganser, cormorant.
Pyrotechnics	GA, AK, HI, ID, KY, MT, MI, NH, NJ, NM, NY, OH, OK, OR, SD, TN, TX, VT, WA, WV	Urban buildings/roost sites, human health & safety (aviation), agricultural crops, fisheries, utilities, poultry, trees, geese	Blackbird, starling, albatros, crow, crane, duck, goose, cattle egret, heron, gull, pacific golden plover, pelican, deer, turkey vulture, tern, magpie, jay, robin, cedar waxwing, cormorant, finch, duck, hawk, osprey, sapsucker.
Lights	MN, WA	Livestock, poultry.	Gray wolf, coyote, raccoon, dog.
Harassment (vehicles)	TN, AK, CA, HI, WA	Human health & safety (aviation).	Albatross, Canada goose, cormorant, duck.

(Continued)

P Appendix

Table P-2(Continued)

Nonchemical Methods Used in Direct Control by the Animal Damage Control Program During FY 1988

Method	State	Resources Protected	Target Species
Other scaring devices Balloons, effigies, flag	GA, AK, ID, NM, TN, VT, WA, HI, ND, MI, OH	Human health & safety/ property.	Blackbird, starling, bulbul, turnstone, Brazilian cardinal, pheasant, mannikin, gull, robin, dove.
Kill/Relocation Methods			
Leghold traps	AK, AZ, CA, CO, HI, ID, KS, LA, MI, MN, MT, NE, NH, NV, NM, ND, NY, NC, OH, OK, OR, TN, UT, VT, VA, WA, WV, WY, WI	Livestock, public health & safety/property, water structures, timber, agricultural research, domestic pets, deer.	Coyote, bobcat, fox, mt. lion, badger, skunk, porcupine, beaver, muskrat, gray wolf, nutria, mink, opossum, cat, dog, marmot.
Cage traps	AZ,, CA, CO, HI, ID, IN, NE, NH, NJ, NM, ND, NV, NY, OK, OR, TN, TX, WA, WI, WY	Poultry, crops/gardens, public health & safety, T&E species, landscaping, livestock.	Skunk, raccoon, pigeon, feral hog, rat, dog, cat, skunk, mongoose, bear, opossum, squirrel, woodchuck, chipmunk, mink rattlesnake.
Neck snares	AZ, CA, CO, ID, IN, KS, MT, NC, NE, NV, NM, ND, OH, OK, OR, TN, TX, UT, VA, WA, WI, WY	Livestock, poultry, trees, timber, water structures, public health/property, agricultural land, highways/roads, orchards.	Coyote, red fox, beaver, dog, skunk, black bear, mt. lion
Foot/leg snares	AZ, CO, ID, NH, NM, NV, OH, OR, UT, WI	Beehives, livestock, poultry, trees, timber, water structures, public health/property, agricultural land, highways, roads, orchards.	Black bear, mt. lion, feral hog, deer, dog, grizzly bear
Quick kill traps	GA, IN, KS, LA, NC, NE, NM, MI, OH, OK, OR, ND, TN, TX, WA, WI, WV	Water structures, orchard trees, highways, botanical gardens, farm ponds, timber, buildings.	Beaver, mole, muskrat, nutria, otter, mink, woodchuck, marmot.
Shooting	AK, AZ, CA, CO, HI, GA, ID, KY, LA, MT, NE, NH, NM, NV, ND, NJ, NYC, NY, OK, OR, OH, TX, TN, SC, UT, WA	Livestock, agricultural crops, human health & safety, timber, water structures, agricultural research plots, state arboretum, highways/roads, farm ponds.	Coyote, black bear, skunk, beaver, red fox, mt. lion, porcupine, dog, dove, raccoon, deer, crow, heron, cattle egret, cardinal, finch, mannikin, pigeon, goose, blackbird..
Aerial hunting (including fixed wing and helicopter)	AZ, CO, ID, MT, NV, NM, OK, OR, TX, UT, WA, WY, NE, ND	Livestock, deer, antelope, geese.	Coyote, red fox, gray wolf.
Calling & shooting	AZ, CA, CO, GA, ID, MT, NE, NV, NM, ND, NY, OH, OK, TX, UT, WA, WY, VA	Livestock, poultry, agricultural research plots.	Coyote, red fox, bobcat, dog, crow, raven
Spot lighting & shooting	MS,, NE, NC, NM, OK, OR, TX, WA, VA, WI	Railroad track, trees, agricultural crops.	Beaver, muskrat, porcupine, pigeon, coyote

(Continued)

Table P-2(Continued)

Nonchemical Methods Used in Direct Control by the Animal Damage Control Program During FY 1988

Method	State	Resources Protected	Target Species
Denning	CO, CA, ID, MR, NV, NM, ND, OK, OR, TX, UT, WA, WY	Livestock, poultry.	Coyote, red fox
Dogs (decoy, tracking, trailing)	AZ, CA, CO, HI, ID, NV, NM, OK, OR, TX, UT, VA, WA	Livestock, poultry, agricultural crops, orchards, trees (timber)	Mt. lion, coyote, raccoon, black bear, fox.
Nest and egg destruction and removal	HI, KS, NH, NM, NY, MI	Equipment, human health & safety.	Pigeon, albatross, starling, finch, Mississippi kite, gull.
Hatchling removal	TN	Human health & safety.	Mississippi kite, goose.

by the injured employee. For this analysis, a "serious injury" was any injury requiring time away from the job. This is a very conservative concept of serious injury. Since the total number of injuries to employees was small, no constructed measures of risk were used. The information is presented in its entirety in the discussions in the text.

Assessment of risks to the public was based on data compiled from a questionnaire completed by APHIS ADC State Directors in December 1991 and January 1992. The State Directors were asked to supply the number of recorded injuries to the public during 1988 - 91, along with details of such injuries.

3. Resource Management

The proper use of resource management methods may successfully protect resources by making the resource base less attractive to or less vulnerable to wildlife damage. Generally, there are four types of resource management methods: animal husbandry, crop selection and planting schedules, habitat management, and modification of human behavior. APHIS ADC personnel do not typically implement these methods, but provide technical recommendations regarding such use by the resource manager or affected party. In some cases, however, APHIS ADC employees may implement a resource management method such as guarding dogs.

a. Animal Husbandry

(1) Use Patterns

Changes in animal husbandry practices can significantly reduce wildlife damage to livestock. APHIS ADC recommends and provides information on night penning, shed lambing, changing the time of breeding, livestock relocation, animal class selection, and livestock guarding and herding by canine or human custodians.

Night penning and shed lambing are both short-term practices used to protect particularly vulnerable livestock. Night penning consists of placing livestock in a confined area, such as a pen or shed, during the night when predators are most active. Similarly, shed lambing involves holding expectant females and newborn lambs in pens or sheds until they give birth or mature. Both practices allow increased surveillance of the animals to prevent predation.

For sheep and cattle, shifting the time of breeding so the birthing schedule coincides with the highest prey to predator ratio can avoid the highest concentration of predators. Livestock may also be moved from unprotected regions to more protected areas.

The use of herders and guarding dogs to protect flocks of sheep on open range or pastures may be used. Several breeds of guarding dogs are raised to live with and protect sheep against predators. The use of guarding dogs was supervised by APHIS ADC in the States of New York and Washington in 1988.

(2) Hazards

(a) Human Health and Safety

The human health and safety hazards of guarding dog use are those associated with normal livestock operations. Farmers and ranchers are regularly exposed to minor injuries in training and caring for these animals. Strangers may be attacked by guarding dogs acting in defense of the livestock being protected.

(b) Environmental

Animal husbandry methods may have adverse effects on nontarget species because of removal of or inaccessibility to food sources. Guarding dogs sometimes attack and kill domestic livestock as well as some wildlife species such as deer. Due to the roaming nature of some individual animals, this hazard sometimes extends beyond the area of protection. This may negatively impact other livestock producers as well as wildlife-related recreational use of the area.

(3) Risks

(a) Human Health and Safety

To minimize human health and safety risks, APHIS ADC recommendations and supervision include technical information concerning proper training and handling procedures of guarding dogs. APHIS ADC recommendations for adoption of specific animal husbandry practices do not add to the risks already associated with ranging and farming. As a part of the technical assistance or supervision provided, when possible, APHIS ADC personnel relate procedures to lower the potential risks to human health and safety. Human health and safety risks associated with animal husbandry are generally limited to the owners and managers of livestock. However, individual guard dogs sometimes exhibit aggressive tendencies which pose a potential risk to the public. This risk is minimal, as the potential for public contact with these animals is relatively low.

(b) Environmental

When appropriate, APHIS ADC recommendations include advice on management of guard dogs and other husbandry techniques to reduce the potential risks to wildlife. The presence of listed T&E wildlife is always considered in all technical assistance provided. Most animal husbandry techniques involve refinements in livestock handling practices and procedures and therefore pose few risks to nontarget wildlife.

No negative impacts to federally listed T&E species are known to have occurred as a result of APHIS ADC use or recommendations.

b. Crop Selection and Planting Schedules

(1) Use Patterns

To reduce wildlife damage, APHIS ADC may recommend planting a different selection of crops, or changing the schedule of planting and harvesting. Before changing crop selection, APHIS ADC recommends a systematic inventory of wildlife in the vicinity and their feeding preferences. Based on this inventory, an array of crops less prone to wildlife damage can be selected.

The coincidence of harvest and wildlife migration patterns often results in high levels of wildlife damage. For example, corn and wheat crops are vulnerable to damage caused by migratory waterfowl. As a remedy, APHIS ADC may recommend changing planting and harvest schedules so harvest will no longer coincide with wildlife migrations, or alternative food sources will be available to reduce damage to valued resources.

(2) Hazards

(a) Human Health and Safety

Health and safety risks associated with these two control methods are those normally associated with agricultural operations. As with animal husbandry methods, it is unlikely that APHIS ADC-recommended use of crop selection and planting schedules adds to the existing occupational risks of farming and ranching. The potential risks for the public of these methods are minimal.

(b) Environmental

Wildlife other than the target species may be adversely affected by these practices. Shifting crop selection and planting schedules may affect food supplies or habitat for nontarget species as well as target species.

(3) Risks

(a) Human Health and Safety

APHIS ADC provides recommendations and technical information to minimize environmental and health and safety risks resulting from the implementation of such methods.

(b) Environmental

APHIS ADC does not recommend practices nor conduct activities that would adversely affect federally threatened or endangered species.

c. Habitat Management

(1) Use Patterns

Changing the architectural design of a building or a public space can often help to avoid potential wildlife damage. For example, selecting species of trees and shrubs that are not attractive to wildlife can reduce the likelihood of potential wildlife damage to parks, public spaces, or residential areas. Similarly, incorporating devices to exclude wildlife into architectural design can significantly reduce potential problems. Grids or screens that prevent birds from entering are an example.

Architectural changes are often most effective if considered during the design stage, rather than after a facility is built.

(2) Hazards

(a) Human Health and Safety

Human health and safety hazards associated with habitat management include those normally associated with construction activities.

(b) Environmental

Environmental hazards include the loss of access to nesting, resting, or feeding habitat.

(3) Risks

(a) Human Health and Safety

APHIS ADC provides recommendations and technical information to minimize health and safety risks resulting from the implementation of such methods.

(b) Environmental

Although the use of architectural design methods may exclude nontarget species as well as target species, such exclusion has minimal adverse environmental effects.

APHIS ADC does not recommend practices nor conduct activities that would adversely affect federally threatened or endangered species.

d. Modification of Human Behavior

(1) Use Patterns

APHIS ADC may recommend alteration of human behavior to resolve potential conflicts between humans and wildlife. For example, APHIS ADC may recommend the elimination of feeding of wildlife that occurs in parks, forests, or residential areas. Many wildlife species adapt well to human settlements and activities, but their proximity to humans may result in damage to structures or threats to public health and safety. Eliminating wildlife feeding and handling can reduce potential problems.

With respect to airport safety, not all potential damage to equipment can be dealt with by relocating bird or other wildlife populations. In such cases, APHIS ADC may recommend that aircraft flight patterns be altered to reduce potential problems.

(2) Hazards

(a) Human Health and Safety

Recommendations to eliminate wildlife feeding and handling or to alter aircraft flight patterns do not entail risks to workers or the public.

(b) Environmental

Nontarget species may be adversely affected because of removal of, or inaccessibility to, food sources or other habitat components.

(3) Risks

(a) Human Health and Safety

APHIS ADC provides recommendations and technical information to minimize environmental and health and safety risks resulting from the implementation of such methods.

(b) Environmental

APHIS ADC does not recommend practices, or not conduct activities that would adversely affect federally threatened or endangered species.

4. Physical Exclusion

The goal of physical exclusion methods is to prevent or reduce the access of wildlife to valued resource, by constructing fences or other physical barriers. Physical exclusion methods are typically recommended by APHIS ADC employees but implemented by resource owners or managers. APHIS ADC does not normally provide fencing, or

construct fences or other barriers as standard operating procedure. However, APHIS ADC may undertake specific projects that entail the loan of material and demonstration of recommended practices.

(1) Use Patterns

Physical exclusion methods are used in most states to minimize wildlife access to livestock and crops. These methods, (which include fencing, netting, and overhead wires), significantly reduce the damage to livestock, crops, buildings, and facilities caused by birds and mammals. Fences may help to prevent damage to farm crops and forest plantations caused by animals such as jackrabbit, deer, and elk. Wildlife exclusion fences constructed of woven wire or multiple strands of electrified wire have proved particularly effective in many cases. Sheathing is often used to protect trees. Hardware cloth, solid metal, or chain links are wrapped around the tree to prevent forest animals from damaging the fruit, flowers, and trunk. Sheathing can also be used to barricade entrances to livestock pens.

Netting consists of placing plastic or wire nets around livestock pens, fish ponds, and agricultural areas. "Vexar" plastic mesh seedling protectors are used to protect newly planted seedling trees against hares, rabbits, deer, elk, and pocket gophers. Wire and plastic netting are also used to exclude a variety of birds and mammals from crops, roadways, nurseries, poultry operations, and other areas requiring exclusion of animals. For example, net enclosures protect fish ponds from foraging birds. Complete enclosures consists of enclosing the ponds and raceways with a screen or net, while partial enclosure usually involves overhead wires, lines, nets, or screens. Although complete enclosure are more effective wildlife excluders, they also cost more. Additional barriers include metal flashing used to prevent entry of small rodents to buildings, and sharp wire or spiked metal strips on building ledges to exclude pigeons, sparrows, and other birds.

APHIS ADC personnel train resource managers and affected parties in the proper positioning of fences and other barriers for optimal protection.

(2) Hazards

(a) Human Health and Safety

Injuries may result while constructing fences or other barriers. Accordingly, care must be taken to avoid accidental entanglement or slippage, or contact with an electric fence. The use of physical barriers as a result of APHIS ADC recommendations is unlikely to add to the normal risk of injury involved in the construction of fences, or to the risks already associated with farming and ranging.

(b) Environmental

Fencing, netting, and other barriers are often effective but may not be selective in excluding only target animals. Nontarget species may be negatively affected. The use of such exclusionary devices may present a total or partial barrier in the normal travel patterns of some wildlife species, thus preventing access to food and water sources. The devices may also cause injury or death from entanglement and may lead to increased concentrations and competition for available habitat.

(3) Risks

(a) Human Health and Safety

The installation of electric fencing by APHIS ADC poses little human risk because of the limited exposure to humans and the training provided to the resource owner. The placement of netting and grid wire presents little human risk.

(b) Environmental

As used by APHIS ADC, injury to nontarget animals is minimal. APHIS ADC does not recommend practices nor conduct activities that would adversely affect federally T&E species.

5. Wildlife Management

Wildlife management methods move or remove wildlife responsible for damage. Non-chemical wildlife management methods include habitat management, the use of lure crops and alternate foods, frightening devices, and kill or relocation methods. Wildlife management methods are implemented by APHIS ADC through direct control, or recommended through technical assistance.

In the following sections, the use patterns and environmental risks of each of the non-chemical wildlife management methods are presented. Because these methods are usually implemented in an outdoor setting, many of the risks to human health and safety are similar to the risks posed by any outdoor occupation. Where reported injuries are associated with particular control methods, appropriate discussion is included. A more extensive discussion of potential human health risks is included at the end of the nonchemical risk evaluation.

a. Habitat Management

(1) Use Patterns

Habitat management techniques alter habitats of target species in or adjacent to locations where such species cause significant damage. Specific habitat management methods include modifying or eliminating vegetation, roost thinning, closing garbage dumps or landfills, manipulating water levels, and removing beaver dams. These efforts alter habitats to discourage the use by target species of the area being protected. The following several examples illustrate this method.

Modifying or eliminating vegetation may be used to eliminate bird nesting and feeding sites or to control wildlife damage in orchards. For example, removing, trimming, or otherwise altering grass, shrubs, brush, trees or standing water may help to reduce potentially harmful bird populations near airports. Maintaining grass cover and ground vegetation at minimal heights also may be help to reduce threats to agricultural operations posed by rodents.

Roost thinning and removal is a technique used to prevent the formation of large roosting concentrations of blackbirds or starlings. The presence of such roosts often results in health and safety problems and damage to buildings and other properties. In roost removal, roosting habitat is eliminated by removing trees, construction of physical barriers, or otherwise restricting the availability of roosting habitat. In roost thinning, available habitat is reduced by selective removal of trees or by pruning branches within trees.

Airport safety is frequently jeopardized by birds that are attracted to garbage dumps or sanitary landfills located near airports. Animals feeding at garbage dumps may pose a threat to ongoing human activity near the dump site. APHIS ADC recommends the closing of garbage dumps or sanitary landfills in locations to lessen potential damage to facilitates and equipment, or harm to humans. Closing dumps and landfills may result in reduced presence of wildlife, and consequent reduced damage to property or danger to humans.

The removal of beaver dams and the resulting lowering of beaver-pond water levels can lessen damage to flooded roads, property, and crops. The dams are removed manually or through the selective use of explosives. APHIS ADC uses both of these methods in beaver damage management activities.

(2) Hazards

(a) Human Health and Safety

Health and safety hazards are those normally associated with cutting, digging, and trimming. The detonation of explosives used in beaver dam removal could result in injury or death to the user and to others in close proximity.

(b) Environmental

Habitat modification may adversely affect nontarget species due to changes to nesting and feeding sites. Nontarget animals may be adversely affected by the use of explosives due to physical impact of the detonation or modification of aquatic habitat.

(3) Risks

(a) Human Health and Safety

APHIS ADC recommendations are unlikely to add to the human health and safety risks associated with habitat modification methods. The handling, storage, transportation, and use of explosives is rigidly controlled. APHIS ADC personnel certified to handle and use explosives receive extensive training approved by the Department of Treasury's Bureau of Alcohol, Tobacco and Firearms; Department of Transportation; and the Institute of Makers of Explosives.

(b) Environmental

The use of explosives by APHIS ADC restores creeks, streams, and other waterways to free-flowing conditions that existed prior to alteration by beaver. APHIS ADC does not recommend practices nor conduct activities that would adversely affect federally threatened or endangered species.

b. Lure Crops and Alternate Foods

(1) Use Patterns

Lure crops and alternate foods may be used to attract wildlife away from critical crops or livestock, thereby preventing potential damage. Lure crops and alternate foods are used when other methods such as crop selection or modified planting schedules are unsuccessful, or in combination with these or other methods.

There are several techniques that may be applied. Lure crops can be planted to divert animals into a specific field or can be planted around a critical crop to keep birds in the area but prevent wildlife damage. Another way to use lure crops is to use grain piles to attract birds. When used in combination with frightening devices, the effectiveness of lure crops is increased. Alternate foods may be used the same way as lure crops, but instead of grains, a goat or other expendable animal is sacrificed to protect livestock such as sheep.

(2) Hazards

(a) Human Health and Safety

Health and safety hazards are those normally associated with farming activities.

(b) Environmental
The use of grain piles and other lure foods may result in concentrated numbers of wildlife such as migratory waterfowl. An increased likelihood of disease transmission could result.

(3) Risks

(a) Human Health and Safety
APHIS ADC recommendations are unlikely to add to the human health and safety risks associated with habitat modification methods.

(b) Environmental
As used by APHIS ADC, injury to nontarget animals is minimal. APHIS ADC does not recommend practices nor conduct activities that would adversely affect federally threatened or endangered species.

c. Frightening Devices

(1) Use Patterns
Frightening devices are used to scare animals from damage sites. Recorded animal distress and alarm calls can be played back at intervals or continuously to frighten target species. Propane exploders and pyrotechnics produce loud explosions at controllable intervals to frighten target species.

Bright lights, flashing lights, and strobe lights sometimes are used to frighten animals that feed at night. Combinations of powerful strobe lights and sirens have also been used to frighten coyotes, and avert depredation of sheep.

Water spray devices implanted around fish ponds may repel certain birds. Such devices operate using sudden bursts of high-pressure spray at random intervals.

Harassment also can frighten predators and help to avoid wildlife damage. Human activity, dogs, boats, planes, automobiles, and all-terrain vehicles are used as harassment methods.

(2) Hazards

(a) Human Health and Safety
The use of harassment devices may affect human health and safety due to auditory and visual disturbances.

(b) Environmental
There is a potential risk of fire from the use of propane exploders or pyrotechnics, particularly if used in grassy areas during dry periods. The use of vehicles may lead to erosion problems or injuries to nontarget animals. Improper or inappropriate use of any of the harassment techniques may result in disturbances to nesting animals. Nontarget animals may be adversely affected because of loss or inaccessibility to food sources or other habitat components.

(3) Risks

(a) Human Health and Safety
APHIS health and safety records do not show any accidents associated with use of this method. Short-term human disturbance may result from the use of auditory or visual frightening devices.

(b) Environmental
As used by APHIS ADC injury to nontarget animals is minimal. APHIS ADC does not recommend practices nor conduct activities that would adversely affect federally threatened or endangered species.

d. Kill or Relocation Methods

(1) Leghold Traps

(a) Description
Leghold traps are mechanical capture devices comprised of a pair of jaws, one or more springs, a base to which the jaws and springs are attached, and a triggering mechanism that secures the trap in a set position until it is stepped on by an animal. A leghold trap captures an animal by gripping its leg or foot. The two basic designs of leghold traps used in the APHIS ADC program are coil-spring and long-spring traps. Leghold traps are available in many sizes. Each size is designed for a specific size class of animal and generally categorizes the width of the jaws. Sizes used in the APHIS ADC program range from the No.1 which is used for small animals, to the No. 4½ which is used for mountain lions.

Leghold traps are used by APHIS ADC personnel to capture the greatest variety of species of any of the control methods used in the APHIS ADC program. Accordingly, leghold traps are one of the most versatile control methods used by the APHIS ADC program. The devices are used in a wide variety of habitat types and damage situations. These devices are used in both aquatic and terrestrial habitats to capture animals for translocation or lethal removal. Use-pattern data indicates that this method is used throughout the year. Leghold traps were also used in wildlife damage control operations in APHIS ADC programs other than in the six MIS reporting states (Table P-3).

Leghold traps are either placed beside or, in specific situations, in travel ways being actively used by the target species. Placement of these traps is contingent upon the habits of the respective target species, habitat conditions, and presence of nontarget animals. In terrestrial settings, leghold traps are placed without baits in travel ways to capture target animals that are routinely using specific routes in the damage area. They are also placed in proximity to commonly used travel ways along with a bait, scent, or lure that serves as an attractant to draw target animals to the traps. Baited traps may also be located in the vicinity of animal carcasses to capture depredating predators that are naturally drawn to the site. In aquatic settings, use is primarily in shallow water at entrance or exit trails or at territorial markings used by target animals. Most aquatic sets are made as drowning sets.

Within applicable restriction of respective State laws, leghold traps are used or may be used nationwide in the APHIS ADC program. Leghold traps are used primarily in rural areas on private and public lands.

(b) Hazards

Human Health and Safety
Human health and safety hazards associated with use of leghold traps are minor. Minor cuts, bruises, abrasions, or fractured bones in the fingers and hands of users may result from handling or accidental discharge of traps during placement. Injuries are related to setting and placement of the devices, making APHIS ADC personnel the most vulnerable to hazard exposure. Trap placement and removal may also result in muscle and back strains. Repeated kneeling to set traps can also result in knee and back strains. Removal of animals from traps exposes users and the public to bites and scratches.

Environmental

Environmental hazards associated with the use of leghold traps include injury or death of both target and nontarget animals. Injuries that may occur include cuts, sprains, broken bones, or interruption of circulation. These injuries may result from the force of the trap closing, efforts of the captured animal to escape, or the length of time that the animal remains in the trap. Death may result from exposure to the elements, post-capture euthanasia by the APHIS ADC technician, or post-release complications. Traps placed to capture one species may capture animals of another species; and traps placed to capture predators may also capture livestock. Traps placed near carcasses to capture predators present a hazard to scavengers, and traps placed in areas frequented by domestic pets present hazards to those animals.

(c) Risks

Human Health and Safety

Risks of human injury by leghold traps is generally restricted to APHIS ADC employees involved in the placement and use of these devices. The use of these devices in rural and urban environments results in exposure to the public, but is primarily restricted to the property or resource owners, or managers (or employees) who receive APHIS ADC assistance. Placement of leghold traps is generally confined to areas not visible to or frequently visited by the public. This further minimizes risk of exposure to the public.

Human health and safety risks to the public are minimized by program guidelines that require warning signs to be posted in the vicinity of control operations. There were no reports of injuries to the public related to the placement of leghold traps by APHIS ADC personnel in 1988.

Training, experience, the use of gloves, trap-setting devices, trap-stake pullers, and other aids ensure the safety of employees. Employee use is evaluated frequently to ensure continued adherence to program guidelines and safety standards. APHIS ADC program injury records for the six MIS states indicates five injuries to APHIS ADC personnel related to use of leghold traps in 1988.

Environmental

Environmental risks are greatest for animals that frequent the area where leghold traps are placed. Leghold traps are used in a variety of habitats, thus many species of wildlife are exposed to leghold traps used by APHIS ADC personnel. Nontarget risks are minimized by the selection of appropriate trap size, use of under-pan tension devices, selection of the appropriate attractant, or bait, and proper site-selection.

Selection of proper trap size generally minimizes risks to nontarget animals that are significantly larger than the target species. Under-pan tension devices generally minimize risks to species weighing less than the target species. Development and use of the appropriate bait, scent, or lure in recognition of the preferences of target and nontarget species minimizes the risks to nontarget animals. Proper site selection increases the likelihood of exposure to the target species while minimizing exposure to nontargets. Site selection involves an understanding of the home ranges, habitat preferences, travel patterns, and population densities of the species present in the area where control operations are being conducted. APHIS ADC program policy also influences site selection by requiring traps placed near animal carcasses to be at least 30 feet away from the carcass. This provides protection for scavenging species.

Protection of domestic pets is generally accomplished by public notices in the form of area warning signs placed in the vicinity of control operations. These signs, which advise the public to restrain their pets, are placed at commonly used access points and along property boundary fences.

In 1988, the six MIS states reported a total take by leghold traps of 21,992 animals. Of these, 16,865 were target animals and 5,127 were nontargets. The total nontarget take represented 37 species and 23.31 percent of all animals taken by this method (Table P-3). Of the nontarget animals taken, 59.74 percent were destroyed. (A complete list of target and nontarget species taken by the APHIS ADC program with nonchemical methods in the six MIS States in FY 1988 appears in Tables P-4 and P-5.)

No federally listed threatened or endangered species were taken as nontargets as a result of APHIS ADC program use of leghold traps in 1988.

(2) Cage Traps

(a) Description

Cage traps, which are used to capture animals ranging in size from mice to bear, have limited application in capturing most large animals. These devices are used primarily on land to capture animals for translocation or lethal removal. Cage traps are normally placed near travel ways and baited with food items as attractants. Capture results from mechanical closure of the entry way via the animal's actuation of a triggering device upon entry, or by the physical construction of the trap opening which allows one-way access only. Placement of the devices is dependent upon the respective target species' habits and habitat conditions and is set to minimize exposure to and capture of nontarget animals.

Cage traps commonly used by APHIS ADC include drop-door wire or solid door box traps for small mammals such as skunks and raccoons; walk-in wire box traps for pigeons, blackbirds, and vultures; walk-in drive traps for flightless waterfowl; suitcase-type Hancock or Bailey traps for beaver; and drop-door culvert traps for bears.

Table P-3

Summary of APHIS ADC Nonchemical Methods Capture Data for 6 MIS[a] States, FY 1988

	Target Species					*Nontarget Species*					*All Captures*				
Method	**D[b]**	**%**	**R[c]**	**%**	**Total**	**D**	**%**	**R**	**%**	**Total**	**D**	**%**	**R**	**%**	**Total**
Leghold Traps	16,542	98.08	323	1.92	16,865	3,063	59.74	2,064	40.26	5,127	19,605	89.15	2,387	10.85	21,992
Cage Traps	13,283	81.66	2,984	18.34	16,267	82	42.05	113	57.95	195	13,365	81.19	3,097	18.81	16,462
Quick Kill Traps	4,797	100.00	0	0.00	4,797	59	100.00	0	0.00	59	4,856	100.00	0	0.00	4,856
Snares	6,887	99.18	57	0.82	6,944	1,486	90.78	151	9.22	1,637	8,373	97.57	208	2.43	8,581
Shooting	10,877	100.00	0	0.00	10,877	20	100.00	0	0.00	20	10,897	100.00	0	0.00	10,897
Aerial Hunting	7,677	100.00	0	0.00	7,677	0	0.00	0	0.00	0	7,677	100.00	0	0.00	7,677

[a] "MIS" refers to the 6 States supplying data from the Management Information System (AZ, CA, OK, NM, TX, UT).

[b] Destroyed

[c] Released

Table P-4

Nontarget Species Captured, Killed, and Released by APHIS ADC Nonchemical Methods in 6 MIS[a] States, FY 1988

Method:	*Leghold Trap*		*Cage Traps*		*Quick Kill Traps*		*Snares*		*Shooting*		*Aerial Hunting*		*Other*	
Species	D[b]	R[c]	D	R	D	R	D	R	D	R	D	R	D	R
Armadillo	1	0	0	2	0	0	0	0	0	0	0	0	0	0
Badger	281	66	0	0	0	0	68	11	0	0	0	0	54	0
Beaver	0	0	0	0	28	0	0	0	1	0	0	0	0	0
Black Bear	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Bobcat	27	119	1	0	0	0	3	2	0	0	0	0	0	0
Coati	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Deer	25	121	0	0	0	0	151	17	0	0	0	0	0	0
Dog	94	215	0	4	0	0	88	46	2	0	0	0	0	1
Fox, Gray	470	573	3	16	0	0	94	2	0	0	0	0	0	0
Fox, Red	32	6	1	11	0	0	7	1	1	0	0	0	0	1
Fox, Kit	61	68	0	0	0	0	8	0	0	0	0	0	0	0
Fox, Swift	5	8	0	0	0	0	0	0	0	0	0	0	0	0
Goat, Feral	1	13	0	0	0	0	1	0	0	0	0	0	0	0
Hog, Feral	8	23	0	0	0	0	8	20	0	0	0	0	0	0
House Cat	42	29	1	59	0	0	6	0	0	0	0	0	0	0
Jackrabbit	116	77	0	1	0	0	70	4	0	0	0	0	0	0
Javelina	271	27	0	0	0	0	490	22	0	0	0	0	0	0
Mink	1	0	0	0	2	0	1	0	0	0	0	0	0	0
Mountain Lion	3	0	0	0	0	0	0	1	0	0	0	0	0	0
Muskrat	1	0	0	0	7	0	0	0	0	0	0	0	0	0
Nutria	0	0	0	0	20	0	0	0	0	0	0	0	0	0
Opossum	284	90	47	14	2	0	5	2	1	0	0	0	0	0
Porcupine	598	64	0	0	0	0	344	13	0	0	0	0	0	0
Pronghorn Antelope	3	1	0	0	0	0	0	0	0	0	0	0	0	0
Rabbit, Cottontail	48	10	1	0	0	0	2	0	0	0	0	0	0	0
Raccoon	601	412	25	1	0	0	133	8	0	0	0	0	0	0
Ringtail Cat	57	105	0	4	0	0	0	0	0	0	0	0	0	0
Russian Boar	0	15	0	0	0	0	5	0	0	0	0	0	0	0
Squirrel, Fox	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Squirrel, Ground	1	0	2	1	0	0	0	0	0	0	0	0	0	0
Weasel	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Rattlesnake	0	0	0	2	0	0	2	0	0	0	0	0	0	0
Turtle	0	0	0	0	46	0	0	0	0	0	0	0	0	0
Blackbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crow	7	0	0	0	0	0	0	0	15	0	0	0	0	0
Exotic Bird	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Hawk/Falcon	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Owls	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Raven	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Road Runner	3	1	0	0	0	0	0	0	0	0	0	0	0	0
Shore Bird	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Vulture	12	14	0	0	0	0	0	1	0	0	0	0	0	0
Wild Turkey	1	2	0	0	0	0	2	0	0	0	0	0	0	0
Total	3,063	2,064	82	113	59	0	1,486	151	20	0	0	0	54	2

[a] "MIS" refers to the 6 States supplying data from the Management Information System (AZ, CA, OK, NM, TX, UT).
[b] Destroyed
[c] Released

Table P-5

Target Species Captured, Killed, and Released by APHIS ADC Nonchemical Methods in 6 MIS[a] States, FY 1988

Method:	Leghold Trap		Cage Traps		Quick Kill Traps		Snares		Shooting		Aerial Hunting		Other	
Species	D[b]	R[c]	D	R	D	R	D	R	D	R	D	R	D	R
Armadillo	0	0	8	1	0	0	0	0	2	0	0	0	0	0
Bats	0	0	0	0	0	0	28	1	0	0	0	0	0	0
Badger	233	5	0	0	0	0	3	0	22	0	0	0	0	0
Beaver	232	0	6	0	4,604	0	208	0	1,807	0	0	0	0	0
Black Bear	1	1	4	0	0	0	38	0	22	0	0	0	0	3
Bobcat	745	81	9	7	0	0	222	1	75	0	40	0	0	0
Coyote	11,108	0	2	0	0	0	5,329	0	4,402	0	7,588	0	0	0
Dog	84	20	0	0	0	0	14	5	31	0	0	0	0	0
Fox, Gray	243	79	75	85	0	0	71	0	23	0	0	0	0	0
Fox, Red	279	12	1	1	0	0	122	0	25	0	27	0	0	0
Hog, Feral	6	0	96	0	0	0	226	0	29	0	22	0	0	0
House Cat	24	4	172	63	0	0	0	0	3	0	0	0	0	0
Jackrabbit	0	3	0	0	0	0	0	0	45	0	0	0	0	0
Javelina	0	4	0	1	0	0	0	2	0	0	0	0	0	0
Marmot	21	0	0	0	0	0	1	0	6	0	0	0	0	0
Mink	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mountain Lion	49	0	3	0	0	0	27	0	40	0	0	0	0	1
Muskrat	61	0	0	0	146	0	0	0	27	0	0	0	0	0
Nutria	29	0	211	0	0	0	0	0	259	0	0	0	0	0
Opossum	88	10	2,458	351	0	0	70	9	6	0	0	0	0	4
Porcupine	115	0	2	1	0	0	13	1	49	0	0	0	0	0
Prairie Dog	0	0	0	0	0	0	0	0	113	0	0	0	0	0
Rabbit, Cottontail	0	2	0	0	0	0	0	0	22	0	0	0	0	0
Raccoon	906	80	1,751	1,418	5	0	272	23	157	0	0	0	0	4
Ringtail Cat	1	0	0	1	0	0	0	0	0	0	0	0	0	0
Russian Boar	7	0	16	0	0	0	151	0	16	0	0	0	0	0
Skunk, Hognose	12	0	1	0	0	0	0	0	0	0	0	0	0	0
Skunk, Spotted	27	0	29	0	0	0	4	0	6	0	0	0	0	0
Skunk, Striped	2,266	1	5,599	3	9	0	63	0	389	0	0	0	0	0
Squirrel, Fox	0	1	3	26	0	0	6	12	3	0	0	0	0	0
Squirrel, Gray	0	0	5	5	0	0	0	0	0	0	0	0	0	0
Squirrel, Ground	0	0	48	8	0	0	1	0	0	0	0	0	0	0
Vole	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Snakes	0	0	0	0	0	0	6	0	0	0	0	0	0	0
Blackbird	0	0	0	0	0	0	0	0	70	0	0	0	0	0
Cormorant	0	0	0	0	4	0	0	0	13	0	0	0	0	0
Cowbird	0	0	2,123	0	0	0	0	0	0	0	0	0	0	0
Crow	0	0	0	0	0	0	0	0	33	0	0	0	0	0
Ducks	0	0	0	8	0	0	0	0	0	0	0	0	0	0
Egret	0	0	0	0	0	0	0	0	25	0	0	0	0	200
Grackle	0	0	296	0	0	0	0	0	1,907	0	0	0	0	0
Hawk/Falcon	1	0	0	0	0	0	0	0	24	0	0	0	0	0
Heron	0	0	0	0	0	0	0	0	34	0	0	0	0	200
Kites, Mississippi	0	15	0	0	0	0	0	0	0	0	0	0	0	1
Owls	0	0	0	0	0	0	2	0	1	0	0	0	0	0
Pigeon, Feral	3	5	235	1,000	0	0	10	0	801	0	0	0	20	0
Quail	0	0	0	5	28	0	0	0	0	0	0	0	0	0
Raven	0	0	1	0	0	0	0	0	87	0	0	0	0	4
Song Bird, Unk.	0	0	0	0	0	0	0	0	100	0	0	0	0	0
Starling	0	0	0	0	0	0	0	0	16	0	0	0	0	0
Swallow/Martin	0	0	0	0	0	0	0	3	0	0	0	0	0	0
Vulture	0	0	129	0	0	0	0	0	185	0	0	0	0	0
Woodpecker	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Total	16,542	323	13,283	2,984	4,797	0	6,887	57	10,877	0	7,677	0	20	417

[a] "MIS" refers to the 6 States supplying data from the Management Information System (AZ, CA, OK, NM, TX, UT).
[b] Destroyed
[c] Released

Target and nontarget species taken by APHIS ADC are listed in Tables P-4 and P-5. Species primarily captured by this method in the six MIS states in 1988 were skunks, raccoons, opossums, and blackbirds. Cage traps were also used in wildlife damage control operations in APHIS ADC programs other than in the six MIS reporting States (Appendix H).

Cage traps may be used nationwide in the APHIS ADC program on privately or publicly owned properties. Use is most frequent in urban areas.

(b) Hazards

Human Health and Safety

Human health and safety hazards associated with use of cage traps are minor. Slight cuts or abrasions to hands, fingers, or arms may result from contact with sharp wire ends. The removal of animals from cage traps may result in animal bites.

Environmental

Environmental hazards associated with the use of cage traps are injury or death of nontarget animals. Use of this trap type usually allows release of captured nontarget animals. Death may occur as a result of entanglement, exposure to the elements, or post-capture euthanasia when release is impractical due to trap-related injury.

(c) Risks

Human Health and Safety

Exposure to human health and safety hazards is minimized as a result of program-implemented procedures. Extensive training and experience of employees ensure development and employment of the skills required to use these devices in a safe and effective manner. Employee use is evaluated frequently to ensure continued safe use practices.

Risk of human injury by cage traps is largely restricted to APHIS ADC employees involved in placement and use. A review of APHIS ADC program injury records reveals no reportable injuries to APHIS ADC personnel directly attributable to the use of cage traps in 1988. There were no reports of injuries to non-APHIS ADC personnel. The use of these devices in rural and urban environments results in exposure to the public, but human health and safety risks are minimal.

Environmental

Environmental risks are minimized through APHIS ADC program implemented features and factors leading to increased selectivity. Proper placement and maintenance of cage traps will generally allow unharmed release of nontarget animals. APHIS ADC operating procedures include the physical placement of cage traps and use of appropriate lures or scents to maximize exposure to target animals and the checking of traps as frequently as possible.

Cage traps are used in a variety of habitats; thus, risks are greatest for those animals that are likely to frequent the areas in which this equipment is placed and which are likely to enter the device. Risks are largely dependent upon an animal's attraction to baits within the trap, trap placement, and the animal's body size. For example, a skunk trap baited with fish would pose no risk to bears because of trap size; likewise, a bear culvert trap baited with the same bait and positioned 2 feet off the ground would pose no risk to skunks because of inaccessibility.

In 1988, the six MIS states reported a total take by this method of 16,462 animals, of which 195 were nontargets. The nontarget take represented 13 species groups and 1.2 percent of all animals taken by this method. Of the nontarget animals taken, 42.05 percent were destroyed (Table P-3).

No federally threatened or endangered species were taken by APHIS ADC use of cage traps.

(3) Quick-kill Traps

(a) Description

Quick-kill traps include several specialized traps such as the Conibear style body-grip trap, and snap, gopher, and mole traps. These devices either crush captured animals between opposing metal jaws or between the jaw and a wooden or plastic base, or impale the animal with sharp metal spikes in subterranean travel ways. These devices are powered by strong metal coilsprings.

Quick-kill these traps are designed to cause the quick death of the animals that activate the devices. These traps are primarily used to control rodent damage.

The use of quick-kill traps in the APHIS ADC program is primarily limited to Conibear style traps, which are employed to control damage caused by mammals such as the beaver, nutria, and muskrat. These traps are used almost exclusively in aquatic habitats, with placement depths varying from a few inches to several feet. Placement is in travel ways or at lodge or burrow entrances created or used by the target species. The animal is captured as it travels through the trap and activates the triggering mechanism.

Snap traps are commonly used to control mice, rats, and voles in and around residential, industrial and agricultural buildings. These traps may also be used in some circumstances to control squirrels and other rodents. APHIS ADC use of these traps is primarily limited to technical assistance involving advice and demonstrations to others on the proper use of these devices.

Gopher and mole traps are designed specifically for the species for which they are named. These devices are designed to control both species within their subterranean habitats. APHIS ADC use of these devices is also limited primarily to technical assistance involving advice and demonstrations to others on the proper use of these devices.

Species primarily captured by quick-kill traps in the six MIS states in 1988 were beaver and nutria. Use pattern data indicates that this method is used throughout the year, but is greatest during the spring, summer, and fall months. This method was also used in APHIS ADC programs in states other than the six MIS reporting states. (Refer to Tables P-4, P-5, and Appendix H for additional details.)

Within applicable restrictions of respective state laws, quick-kill traps may be used nationwide in the APHIS ADC program. They are used primarily in rural, private land areas but may occasionally be used in urban or suburban areas and on publicly-owned properties.

(b) Hazards

Human Health and Safety

Human health and safety hazards associated with use of quick-kill traps varies with trap size and type. Minor injuries, including cuts, bruises, or abrasions, may occur to the fingers and hands from handling and setting the smaller traps. The large beaver-size Conibear style trap is capable of causing more serious injury such as bone fractures in arms, hands, and fingers. Safety hazards are usually related to setting, placing, checking, or removing the devices.

Environmental

Environmental hazards include injury or death of nontarget animals. Hazards to nontargets are generally confined to a small area in the vicinity of the damage site. Most animals captured in these traps die quickly. A small percentage of the animals captured in these traps may be released.

(c) Risks

Human Health and Safety

Risks of human injury associated with the use of quick-kill traps are generally restricted to the users of these devices. The use of these devices in both rural and urban environments results in exposure to the public but is primarily restricted to property or resource owners or managers, or employees who receive APHIS ADC assistance. No APHIS ADC employee injuries directly attributable to quick-kill trap use were reported in 1988. Additionally, there were no reports of injuries to the public attributable to quick-kill traps placed by APHIS ADC personnel.

Human health and safety risks to the public are minimized by program guidelines which require warning signs to be posted in the vicinity of control operations. Placement of quick-kill traps in aquatic environments and on predominantly private lands in areas generally not visible or accessible to the public also minimizes the exposure of these devices to the public.

Extensive training of new employees ensures development of the skills required to use and demonstrate the use of these devices in a safe and effective manner. Employees are evaluated frequently to ensure continued adherence to program guidelines and safety standards.

Environmental

Environmental risks associated with the use of Conibear style quick kill traps are generally limited to aquatic species in the general area where these traps are placed. Environmental risks associated with the use of snap traps are generally limited to domestic animals since these traps are normally used in and around residential, industrial, and agricultural buildings. Environmental risks associated with the use of mole and gopher traps are minimal since few, if any, nontarget animals occupy the subterranean habitat where these devices are placed.

Environmental risk to nontarget animals are also minimized through the selection and use of the appropriate size of trap. Conibear style traps commonly used in beaver control operations present a minor risk to many small nontarget animals because they are small enough to safely pass through the trap without disturbing the triggering mechanism. Conversely, small traps present little risk to animals that are too large to enter the traps.

Placement of these devices at or in den or burrow entrances of target species minimizes nontarget exposure since the target animals are the most frequent users of these openings.

In 1988, the six MIS states reported a total take by this method of 4,856 animals; of these 4,797 were target animals and 59 were nontargets. The total nontarget take represented 6 species and 1.2 percent of all animals taken by this method (Table P-3). All nontarget animals were destroyed.

No federally listed threatened or endangered species were taken.

(4) Snares

(a) Description

Snares are capture devices comprised of a cable loop and a locking device. Most snares are also equipped with a swivel to minimize cable twisting and breakage. Snares are designed to tighten around an animal's body as it passes through the device. A snare may be placed in a vertical position to capture an animal as it passes through the loop, or it may be used horizontally with a trigger and spring activated throw-arm to capture the animal by the leg when it steps in the loop.

Catch poles are hand-held snaring devices used primarily to remove live animals from traps or confined areas such as buildings, without danger to or from the captured animal.

Snares are used by APHIS ADC personnel primarily to control damage caused by mammals such as beaver, coyote, mountain lion, and bear. These devices are used in aquatic and terrestrial habitats to capture animals for translocation or lethal removal. Use-pattern data indicates that this method is used throughout the year. Snares were also used in APHIS ADC programs in states other than the six MIS reporting states (Appendix H).

Snares are normally placed in travel ways, and capture is around the neck, body, or leg. APHIS ADC personnel generally use two types of sets, — trail sets and baited sets. In both situations the snares are placed in restricted travel ways where the animal is forced to travel over or through the device. Most neck or body snares used in terrestrial habitat are placed in or under fences where evidence indicates that the target animal is entering the area where damage is occurring. Neck snares used in aquatic habitat are usually placed in shallow water at water entrance or exit trails, lodge entrances, or territorial marking sites used by target animals. Placement of snares is dependent upon the habits of the respective target species and habitat conditions. Placement location is selected to minimize exposure to and capture of nontarget animals. For a list of target and nontarget species, refer to Tables P-4 and P-5.

Within applicable restrictions of respective state laws, snares are used or may be used nation-wide in the APHIS ADC program. Dependent upon snare type and circumstance, use may occur in rural or urban areas and on privately or publicly-owned properties.

(b) Hazards

Human Health and Safety

Human health and safety hazards associated with use of snares are minor. Abrasions, bruises, and minor cuts to the fingers, hands and arms of users may result from inadvertent release of the spring mechanism of leg snares. Minor cuts to hands and fingers may also occur from broken strands of cable or frayed cable ends.

Environmental

Environmental hazards associated with the use of snares are injury or death of nontarget animals. Injuries generally involve abrasions, cuts, and bruises or constriction of blood flow. Death may result from strangulation, exposure to the elements, or humane disposal by an APHIS ADC technician.

(c) Risks

Human Health and Safety

Risk of human injury by snares is generally restricted to APHIS ADC employees involved in placement and use of snares. The use of these devices in rural and urban environments results in exposure to the public but is generally restricted to property or resource owners who receive APHIS ADC assistance. No employee injuries directly attributable to snare use were reported in 1988. Additionally, there were no reports of injuries to the public attributable to snares placed by APHIS ADC personnel.

Human health and safety risks to the public are minimized by program guidelines that require warning signs to be posted in the vicinity of control operations. Training, experience, and the use of gloves to protect hands and fingers ensure the safety of employees. Employee use is evaluated frequently to ensure continued adherence to program guidelines and safety standards.

Environmental

Environmental risks are greatest for animals that frequent the area where snares are placed and travel along the paths of the target species. Neck and body snares are used in a variety of habitats; thus, many species of wildlife are exposed to snares used by APHIS ADC personnel. Nontarget risks are minimized by adjustment of loop size and height of placement. Proper loop size and height placement allows animals smaller than the target species to pass through or under the devices unharmed. Leg snares are generally used to

capture bears and mountain lions. The limited distribution and use of these devices minimizes the exposure of leg snares to nontarget animals. Under-pan tension devices excludes the capture of animals weighing less than the target species.

In 1988, the six MIS reporting states reported a total take by this method of 8,581 animals; of these, 6,944 were target animals and 1,637 were nontargets. The total nontarget take represented 22 species and 19.1 percent of all animals taken by this method. Of the nontarget animals taken, 90.78 percent were destroyed. (Refer to Tables P-3 and P-4.)

No federally listed threatened or endangered species were taken by the APHIS ADC program as a result of the use of snares.

(5) Shooting

(a) Description

Ground shooting, with rifles and shotguns, is employed to remove target animals through harassment or lethal removal. Shooting for harassment purposes generally involves the use of shotguns. Shooting in the direction of, but not at, target animals is sometimes augmented by intentional shooting of individual target animals. The intent of such shooting is to enhance the scaring efficiency of firearms and pyrotechnics by training the birds to anticipate injury when they hear explosions. This method is applied in behavior management of birds such as blackbirds, crows, cormorants, and herons.

Shooting to kill may be accomplished by shooting on sight or by calling and shooting. This method may be employed in various habitat types, at night or during the daytime, using shotguns and small and large caliber rifles. Species primarily removed by this method in the six MIS states in 1988 were coyotes, beaver, and blackbirds. Target and nontarget species are listed in Tables P-4 and P-5. Shooting was also used in wildlife damage control operations in APHIS ADC programs other than in the six MIS reporting states (Appendix H). It is also employed to humanely destroy animals captured in various capture devices.

Shooting is used or may be used throughout the year in the APHIS ADC program and is most frequently used in rural areas on privately or publicly owned properties.

(b) Hazards

Human Health and Safety

Human health and safety hazards associated with use of shooting are highly variable dependent primarily upon the skill of the user and firearm type. Hazards to the user may include: shoulder bruises from firearm recoil, hearing damage from sustained noise exposure without proper hearing protection, eye damage from fired ammunition debris, and self-inflicted gunshot due to improper firearm handling. Hazards to the non-user include hearing damage, if in close proximity to the firearm, and gunshot wound.

Environmental

Environmental hazards associated with shooting are minimal. Hazards to nontargets are confined to animals which may be mistakenly identified or those which inadvertently enter the path of firearms during harassment activities.

(c) Risks

Human Health and Safety

The primary human health and safety hazard associated with shooting is related to firearms handling by the user, making APHIS ADC personnel the most vulnerable.

Human health and safety risks are minimized as a result of program-implemented safety practices. Extensive training and experience of employees ensure development and employment of the skills required to use firearms in a safe and effective manner. Firearms

are employed safe distances from human habitations and other activities, and are fired in safe directions only. Employee use is evaluated frequently to ensure continued safe-use practices.

A review of APHIS ADC program injury records reveals no reportable injuries to the public or APHIS ADC personnel attributable to shooting in 1988.

Environmental

Environmental risks are greatest for those nontarget animals similar in appearance to target animals. Environmental risks are minimized through training of APHIS ADC personnel in species identification, resulting in shooting as a highly selective damage control method. The various types of shooting activities are very selective in taking target animals and may be used in areas where exposure to sensitive species is likely.

In 1988 the six MIS states reported a total take by shooting of 10,897 animals of which 20 were nontargets. The nontarget take represented 6 species groups and 0.18 percent of all animals taken by this method (Table P-3). All nontarget animals were destroyed.

No federally listed threatened or endangered species were taken by the APHIS ADC use of shooting.

(6) Aerial Hunting

(a) Description

Light fixed-wing aircraft and helicopters are used extensively for the hunting or hazing of animals to alleviate damage and for the taking or capturing of animals for various research projects.

Aerial hunting involves the removal of target animals through shooting from helicopters or fixed-wing aircraft; this method is used primarily to control livestock losses caused by coyotes. Aerial hazing involves the use of aircraft to harass or frighten populations of depredating birds; this method is used primarily to control crop losses caused by depredating birds. Aerial hunting and hazing are used primarily in rural areas of the Western States on both private and public properties. All flight activities are conducted in accordance with the Airborne Hunting Act (50 CFR Chapter 1, Part 19), Federal Aviation Agency regulations, and APHIS ADC program Aviation Safety and Operations guidelines.

Research projects involving the use of aircraft include observation, tracking, and taking of various animals that cause agricultural crop losses or threats to human health or safety. Operations involving the capture of animals generally include the use of net or tranquilizer guns to immobilize specific animals for use in research studies.

Fixed-wing aircraft are used primarily over open, flat, or gently rolling terrain and at lower elevations. Helicopters, because of better maneuverability, have greater utility and are safer over brushy ground, timbered areas, or broken land and mountainous areas where animals are more difficult to see. Flight operations are conducted close to ground level and at low airspeeds. Flight crews consist of a pilot and a gunner. Firearms commonly used are shotguns firing shotshell ammunition. Limitations due to weather, terrain, density altitude, vegetative cover, and related safety restrictions may limit the use of this highly selective method.

Use-pattern data indicates that this method is used throughout the year, but use is greatest during the fall, winter, and spring. APHIS ADC reported 6,000 aerial hunting and hazing operations in excess of 17,000 flight hours in 1988.

(b) Hazards

Human Health and Safety

Human health and safety hazards associated with aerial hunting are related to low-level aircraft operations and the use of firearms. Hazards to the flight crew include: crashes due to mechanical failure, environmental conditions, or pilot error; shoulder bruises from firearm recoil; hearing loss from sustained exposure to noise of aircraft and repetitive firearm discharge; eye damage from discharged ammunition debris; physical injury from firearm or ammunition failure; and self-inflicted gunshot due to improper firearm handling.

Hazards to non-APHIS ADC personnel are minimal and are limited to flight activities at and near airports and inhabited areas.

Environmental

Environmental hazards associated with shooting are minimal, as this method is highly selective for specific target animals. Hazards to nontargets are confined to animals that may be mistakenly identified or those which inadvertently enter the path of fire during harassment activities.

Localized environmental hazards associated with aircraft crashes include fires and fuel spills.

(c) Risks

Human Health and Safety

Risk of human injury from aerial hunting and hazing is restricted primarily to APHIS ADC employees and contract pilots. Limiting flight operations to primarily rural environments essentially eliminates public exposure and thereby minimizes any risks to the public. No injuries to APHIS ADC personnel, contract pilots, or the public were reported as a result of APHIS ADC program use of aircraft in 6,000 aerial hunting and hazing operations in 1988.

Mandatory training requirements, safety standards and procedures, certification requirements, and strict maintenance schedules are applied uniformly to ensure the safety of flight crews and flight operations. When contract services are involved, both aircraft and pilot must meet rigid requirements before they are certified to begin operations. All aircraft are maintained regularly. Employees and contract pilots are closely monitored to ensure that their abilities are not impaired and that they do not deviate from established safety standards.

Flight crew members are required to wear protective eye, ear, and head gear, including fire retardant clothing. Firearms handling and use restrictions are employed to minimize risks to the aircraft, fellow crew members, or the public. Flight operations may be suspended by either crew member due to bad weather, aircraft malfunction, or other reasons which may affect the safety of the flight. Aerial hunting is not conducted near human habitations or other human activities.

Environmental

Environmental risks are primarily limited to animals similar in size and appearance to target animals. Environmental risks are minimized through training of APHIS ADC personnel in species identification to ensure that shooting from aircraft is a highly selective damage control method. It may be used in areas where exposure to sensitive species is likely.

In 1988 the six MIS reporting States reported a total take by aerial hunting of 7,677 animals. No nontarget animals were taken by this method (Table P-4).

No federally listed threatened or endangered species were taken by the APHIS ADC program by aerial hunting.

(7) Egg, Nest, and Hatchling Removal and Destruction

(a) Description

Nesting populations of birds, especially if located near airports or in residential areas, may pose threats to public health and safety as well as property. Additionally, competition for limited nesting habitat may result in negative impacts on other species of special concern. Nest destruction and removal of eggs and hatchlings is used to control or limit the growth of a population in a specific area or to augment other management methods implemented to move the population to other areas.

(b) Hazards

Human Health and Safety

Human health and safety hazards associated with APHIS ADC use of these methods are minor and are generally limited to APHIS ADC employees. Injuries may be sustained from attacks by birds defending their nests or territories; and from climbing, walking, or similar outdoor activities.

Environmental

These methods present no hazards to nontarget animals.

(c) Risks

Human Health and Safety

There were no reports of injuries to APHIS ADC personnel associated with use of these methods in 1988.

Environmental

Because of the target-specific nature of these methods, there were no adverse impacts to nontarget animals.

D. Risk Assessment for APHIS ADC Chemical Methods

1. Introduction and Overview

The importance of chemical methods to the overall APHIS ADC program mandated adoption of a quantifiable, widely accepted approach to evaluating potential impacts associated with the application of vertebrate pesticides. QRA is an approach frequently practiced in response to diverse Federal, State, and regional regulations for the purpose of evaluating and quantifying potential impacts associated with exposure to pesticides or other compounds. To promote comparability and reproducibility, this chemical risk assessment employed a widely used, generally accepted paradigm for conducting such a risk assessment (NAS 1983). This paradigm stipulates the key components of the risk assessment process (data evaluation, exposure assessment, toxicological assessment, and risk characterization). Because the focus of the document is ecological risk assessment in particular, it also incorporates Federal-level guidance provided by Barnthouse et al. (1986), Warren-Hicks et al. (1989), Hazard Division Evaluation procedures (USEPA 1986e), the USEPA Risk Assessment Forum (USEPA 1992aa and 1991c), and other widely accepted sources.

The chemical risk assessment examines adverse effects potentially associated with either human or ecological exposure to any of the chemical pesticide compounds used nationwide by APHIS ADC for direct control of vertebrates during FY 1988 through 1991. The emphasis of the risk assessment is placed upon potential effects to wildlife, especially those designated as Threatened or Endangered under the Endangered Species Act of 1973, as amended. It also addresses potential effects associated with exposure to wildlife or communities not included under the Endangered Species Act (i.e., nonlisted species). The risk assessment also considers potentially exposed humans, such as recreational receptors (e.g., hunters, hikers), residential receptors (e.g., local residents), or occupational receptors (e.g., pest control operators). Such workers, ostensibly the single most exposed group, are protected by provisions in the FIFRA, which specifies worker-protective measures, and additional, more general protection under the Occupational Safety and Health Act (OSHA).

Product labels play a key role in the risk assessment due to the express provisions under FIFRA that it is a violation to use a pesticide "in a manner inconsistent with its labeling." Where no label restrictions have been established, the risk assessment addresses the potential for impacts to occur under label-specified application and use pattern scenarios.

In 1972, Congress passed major amendments to FIFRA, which established the basic form of the present Federal pesticide regulatory structure, to ensure that the economic, social, health, and environmental benefits of chemical pesticides would not be outweighed by potential adverse environmental impacts. To this end, it is a primary objective of USEPA's registration procedure to evaluate potential environmental risk associated with product use and to assist the Agency to weigh the effects of canceling or removing registration against the effects on food production, prices, or other protected resources. As evidence of the value of FIFRA in supporting a quantitative risk assessment, the four main thrusts of the legislation include: (1) evaluating the risks associated with pesticide use through registration requirements; (2) classifying and certifying pesticides for specific uses and thereby controlling exposure; (3) suspending, canceling, or restricting pesticides posing potential environmental risks; and (4) enforcing these requirements through inspections, labeling notices, and regulation by State authorities. Because the nationwide APHIS ADC program encounters potentially complex use patterns and related nontarget exposures, it was the intent of this chemical risk assessment to consider those potential exposures not expressly covered by these provisions.

In analyzing and documenting the rationale for considering potential effects on human health and the environment resulting from use of APHIS ADC chemical control methods, the risk assessment produces several forms of output. It identifies potential exposure pathways directly or indirectly associated with the point of pesticide application, identifies

key indicator species potentially at risk, characterizes the toxicological properties by product, quantifies the extent to which exposures could occur, and characterizes the nature of potential impacts associated with the application of pesticides.

a. General Chemical Methods Background

This section discusses the general characteristics of APHIS ADC chemical methods under consideration. These methods are important components of the APHIS ADC program's Integrated Pest Management (IPM) approach to wildlife damage management.

(1) Description and Discussion of Chemical Methods

Table P-6 provides a list of all active ingredients (a.i.) in chemical methods used by APHIS ADC for either technical assistance or direct control activities. Most of these products are used in both direct control and technical assistance. APHIS ADC recommends only chemical methods that have been registered by USEPA or an appropriate regulatory agency (APHIS ADC Directive 4.050)

There is an important distinction between chemical methods actually used by APHIS ADC for direct control as opposed to those for which only technical assistance is offered. Potential environmental consequences of materials used in technical assistance or direct control are not expected to differ significantly if products are used according to USEPA label specifications. However, APHIS ADC does not monitor or control chemical uses by persons not employed or supervised by APHIS ADC. Therefore, this risk assessment concentrates on chemicals used by APHIS ADC in direct control. The conclusions generally apply to technical assistance uses as well so long as USEPA approved labeling and use directions are similar for direct control and technical assistance applications.

In order to determine which chemical methods were used for direct control during FY 1988 through 1991, a questionnaire was sent to each APHIS ADC State Director, and responses were incorporated into this portion of the EIS. Table P-7 summarizes basic information about the products used by APHIS ADC for direct control during FY 1988 through 1991; these products were the focus of the risk assessment.

(a) APHIS ADC Chemical Methods Use Pattern Data

Table P-7 represents the specific use pattern data for chemical methods used by APHIS ADC for direct control during FY 1988 through 1991. The table lists the name of both the active ingredient and formulated end-use product, State or Federal registration numbers, formulation-specific data (percent a.i., etc.), maximum reported application rates and frequencies, states where used and maximum annual use by State, percent use distribution by season of year, target species and resources protected, and key representative nontarget species potentially affected by its application. This information was obtained from many sources, including registration labels, APHIS ADC State Directors, other personnel, and literature, and represented a critical body of information for conducting the chemical methods risk assessment.

(b) Formulation Types and Methods of Application

The chemical methods can be grouped based on the mode of application. For example, the specific type and placement of bait, whether it is in plain view or underground, and if it could easily be carried from the site of application can determine which species ultimately consume the poison. The chemical methods under review have been classified into eight general categories, including grain baits and pellets, paste baits, block baits, food baits, fumigants, direct contact devices, repellents/poisons, and habitat manipulation. A general description of each category follows.

- **Grain baits and pellets.** This type of bait is used for birds and rodents. Grains used in baits for the APHIS ADC program include wheat, mixed grains, oats, milo, and corn. The end-use products that incorporate grain include 4-aminopyridine,

DRC-1339, and strychnine for avian species and zinc phosphide and strychnine for rodent species. Grain baits are small in size and usually distributed in several locations in the treatment area.

Grain baits are scattered in feedlots, on structures, around livestock pens, and around fields. They are also placed at feeding stations at higher concentrations within smaller areas. DRC-1339, 4-aminopyridine, and strychnine are mixed with an additive to adhere the active ingredient to the bait, which serves to reduce off-site transport potential while maintaining bait effectiveness. Zinc phosphide baits are placed on field perimeters or in rodent burrows. Strychnine baits placed underground with burrow builders for use in rodent control have rarely been shown to contribute to above ground spillage. Spillage could occur, however, if the nozzle is plugged or removed from the burrow. Aboveground spillage is generally buried by applicators, which reduces aboveground exposure potential (Schafer 1991b).

- **Paste baits.** Strychnine paste is used at 1.6 percent and 4.9 percent concentrations. These two formulations are used in three different baiting methods, including above- and below-ground application. The paste is applied to food items of target species. Control is obtained through ingestion of bait coated with toxicant paste. Other indirect exposure pathways are possible when the bait is placed. For example, dermal absorption of underground paste was a possible cause of death in deer mice, primarily through fern fronds used as bait for controlling mountain beaver (Evans 1987a). Another possible pathway for above-ground applications could include surface water runoff. Runoff can dissolve the paste and release strychnine, which is relatively insoluble. The off-site transport potential of strychnine and other active ingredients is characterized in detail in later sections of this report.

- **Block baits.** Two formulations are used; the strychnine salt block for porcupines (5.79% a.i) and brodifacoum Weather Blok. Strychnine salt blocks are nailed to trees above the ground, an important factor when determining potential nontarget exposures because the bait is then removed from the reach of browsing animals. However, it could still be accessible to nontarget tree-dwelling species. When rodent infestations occur aboveground, the brodifacoum Weather Blok is tied or fastened to trees, fences, or other overhead areas. The block baits are solid and compact and thus have little potential for transport from the area of application.

- **Nongrain food baits.** Nongrain food baits are mixed by APHIS ADC personnel, usually at the site of application, to exploit specialized food preference by target species. The active ingredients include DRC-1339, 4-aminopyridine, alpha chloralose, zinc phosphide, and strychnine. Foods commonly used include french fries, cut raw potatoes, bread and meat cubes, eggs, alfalfa tips, and carrots. Some unusual baits (e.g., dandelion greens and dog food) are occasionally used to ensure target specificity.

- **Fumigants.** Sodium nitrate and aluminum phosphide are used as fumigants in predator dens or rodent burrows. These are placed as tablets or capsules in the burrows and activated either by burrow moisture or with lighted fuses to produce lethal gas, which is then inhaled by target species.

- **Direct contact devices.** This group includes the two formulations that are activated by the target species, including the M-44 cyanide ejector and the Compound 1080 Livestock Protection Collar. Control is achieved when these devices are pulled (M-44) or penetrated (1080 LP Collar) by the target predator.

- **Odor repellents/surface poisons.** Odor repellents are designed to deter or repel target species from protected resources, such as ornamentals or crops, and include polybutene and bone tar oil. These formulations are administered as viscous liquids placed on surfaces. Surface poisons are liquids applied to perches and roosts or sprayed on surfaces. Fenthion, for example, is a dermal toxicant used to control target birds on perches near protected areas. This product is placed within hollow

perches and absorbed through target species' feet. This end-use formulation may also be sprayed in areas with roosting surfaces. Neither Tergitol (Compound PA-14) nor mineral oil act as direct toxicants, although both sprays are lethal. Tergitol is a detergent, or surfactant, which reduces the insulating capacity of the target birds' feather covering, resulting in hypothermia. Mineral oil is sprayed directly on the eggs, causing suffocation of target bird eggs.

- **Habitat manipulation.** The herbicide glyphosate is used to disperse blackbird concentrations by removing prime roosting habitat in marshes or wetlands. Cattails represent the target habitat for control of blackbirds. Glyphosate is applied to key roosting areas located near grain or sunflower fields, feedlots, or other areas where birds are causing damage.

b. Overview of Chemical Methods Risk Assessment Approach

The chemical methods risk assessment procedure consisted of several steps, as follows:

- Defining the complete list of available chemical methods, including those used for both technical assistance and direct control.
- Separating those materials used for only technical assistance from those used for direct control by the program.
- Collecting key information, including use pattern, potential nontarget receptors, and compound-specific environmental fate and toxicological properties;
- Using this information to screen compounds (i.e., designating them as *no probable risk compounds* or *compounds requiring quantitative risk assessment*).
- Conducting quantitative risk assessment, which involved:
  - Analyzing each compound on the basis of off-site transport potential (minimal or significant), including defining key potential pathways and receptors.
  - Conducting quantitative exposure assessment and risk characterization for those compounds found to have significant off-site transport potential.
- Using these findings to form the basis for deriving conclusions and recommending mitigation measures for the compounds determined to pose potential risks.

Figure P-1 presents a flow scheme for the chemical methods risk assessment. The tiered approach outlined in Figure P-1 was used to maximize the effectiveness of the analysis.

In general terms, each tier involved increasing levels of rigor or detail designed to screen out chemical methods not likely to require more detailed analysis to determine the likelihood of risk. As shown in Figure P-1, these levels (tiers) are *critical element screening*, *scoring procedures*, and *QRA*. At each tier, if a *no probable risk* designation is made, the method (end-use formulation) is carried forward directly to documentation rather than subjected to further analysis. This approach was designed to be systematic, thorough, and subject each chemical method to the appropriate level of analysis. Additionally, the approach served to reduce the chance that a potentially harmful product could erroneously be removed from further analysis. Figure P-1 also depicts how conclusions and mitigation measures were recommended for further analysis.

Figure P-2 shows in more detail key decision points and components of the analysis for pesticide formulations requiring quantitative risk assessment. These key decision points begin with screening, which results in identifying products or methods requiring quantitative risk assessment. Subsequent key decision points include:

- Determination of the potential for off-site transport, which involves derivation of toxicological benchmarks and identification of exposure pathways.

- Development of quantitative exposure assessment, which involves analysis of estimated environmental concentrations of products for each pathway.
- Determination of *Hazard Quotients* (HQ), which are standardized measures of potential risk, characterization of risk, and estimation of uncertainty.

Each of these decision points was used to designate a product as unlikely to have an effect (*no probable risk*) or likely to cause an effect.

c. Key Assumptions

Key assumptions involving the geographical units of analysis, the use of detailed models of exposure scenarios, and the role of threatened and endangered species need to be explicitly stated at the outset. In keeping with the programmatic emphasis of the analyses conducted throughout this EIS, the geographic unit of analysis is a State. Data was collected for each State. No attempt was made to analyze specific sites or ecosystems within

Table P-6

Technical or Common Names of Active Ingredients in Chemical Methods Recommended or Used by the APHIS ADC Program During FY 1988 through 1991[a]

Alpha-chloralose (bird immobilizer)
Aluminum phosphide (Phostoxin, Fumitoxin, Detia-Rotox)
4-Aminopyridine (Avitrol)
BGR (Big Game Repellent)[b]
Bone tar oil (Magic Circle deer repellent)
Brodifacoum (Weather Blok)
Bromethalin[b]
Chlorophacinone[b]
Cholecalciferol
Compound PA-14 (Tergitol)
Diphacinone[b]
DRC-1339
Fenthion (Rid-a-Bird; BCF #1)
Glyphosate
Hinder (repellent)[b]
Immobilizing/euthanizing agents (Ketaset, Buthanasia-D, Rompun)
Mesurol[b]
Mineral oil
Ornitrol[b]
Pivalyn[b]
Polybutene (Eaton's 4 the Birds)
Sodium cyanide
Sodium fluoroacetate (Compound 1080)
Sodium nitrate (gas cartridges)
Strychnine
Warfarin[b]
Zinc phosphide

[a] "Recommended" refers to APHIS ADC technical assistance; "Used" refers to APHIS ADC direct control activities.

[b] These chemicals were recommended in technical assistance but not used in direct control by APHIS ADC during FY 1988 through FY 1991.

a State, or ecosystems that may be of a regional character. In general, the use of the State as the unit of geographic analysis may overestimate potential risks. For example, both a specific T&E species and a specific chemical method may be listed as occurring within a particular State's boundaries. However, the actual use of the method and the reported habitat may not overlap. In this analysis, the method may be identified as posing a potential risk, despite the fact that use of the chemical method may not overlap with the habitat of a specific T&E species.

In the quantitative risk assessment, detailed models of specific locations and climate conditions are used to examine exposure scenarios for specific chemical methods. For example, to examine how runoff caused by storms would affect the concentration of DRC-1339 in soil, the analysis used a database of soil conditions and historic rainfall records to identify potential effects. The model identified a particular location as having the soil type required for the analysis. Then, rainfall data for that location was reviewed to identify the actual year or years that would best simulate the conditions to be analyzed. For DRC-1339, two applications of the chemical were analyzed; these two applications simulate the annual use pattern. The model, which is based on actual data, is treated in the analysis as a scenario or representation of specific conditions defining the exposure scenario, not as an analysis of the location itself.

As noted earlier, the emphasis in the risk assessment has been placed on threatened and endangered species. The assumption inherent in this emphasis is that threatened or endangered species will be most sensitive to potential impacts of the APHIS ADC program. As a result, discussion of potential risks to these species may appear to be given priority. However, it is important to keep in mind that the chemical risk assessment *does* address nonlisted species, APHIS ADC employees, and the public, as well as listed species.

The next section discusses the data required to conduct the project, including types and sources of data. Then, a detailed discussion of the screening procedure used to designate compounds as *no probable risk* or *requiring QRA* is presented. This is followed by a detailed discussion and documentation of the approach used to conduct the QRA. This approach includes an overview of the methodology, the exposure assessment, the toxicity assessment and delineation of benchmark values, and risk characterization and uncertainty analysis.

A detailed discussion of results by each formulated product including critical element screening, numerical scoring, quantitative risk assessment, and the T&E species evaluation is then presented. Where multiple formulations were used, the discussion is focused on the active ingredient where applicable. The programmatic conclusions, along with a comparison with other parallel efforts (Biological Opinions, etc.) and recommended mitigation measures are also included.

2. Project Data

a. Overview of Data Needs

Many diverse types of data were required to conduct the chemical methods risk assessment. Much of this information was specific for each compound or end-use formulation and included: (1) **use pattern data**, including States in which each product was used, application rates and frequency, modes of application, seasonality of use, resources protected, and target species; (2) **exposure data**, including potential nontarget receptors (human and nonhuman) and susceptible habitats and chemical and environmental fate data; and (3) **toxicological data**, including acute and chronic toxicity information (including both primary and secondary endpoints) for avian, mammalian, and aquatic species. General use pattern data for each direct control chemical method is detailed in Table P-7. Compound-specific data including dose-response (toxicological) and environmental fate information is presented in the section on Risk Assessment Screening (page P-49).

Table P-7

Chemical Methods Used by APHIS ADC for Direct Control During FY 1988 through FY 1991–Specific Use Pattern Data

A.I./Product Name	Registration Numbers	Formulation	Maximum Application Rates	Maximum Application Frequency
Avicides & Other Agents				
Alpha-chloralose for Bird Capture	INAD6602	99.50%	1 bait/bird	
4-Amino-pyridine (Avitrol)	11649-1,-4,-6,-7	0.5% on grain	ratio of 1 part treated to 5 parts untreated	4 times per site per year [a]
4-Amino-pyridine (Avitrol)	11649-10	25% on bread		
DRC-1339 (feedlots)	56228-10	98%	4 g (a.i.) per 100 m^2	once/year per site
DRC-1339 (structures)	State labels[b]	98%	25 lbs/acre of 0.5% a.i.	twice/year per site
DRC-1339 (staging areas)	State labels	98%	100 lbs/acre (0.5% a.i.)	twice/year per site
DRC-1339 (gull toxicant)	56228-17	98% powder	110 mg a.i. (5 units) per gull	10 bait applications per colony per year
DRC-1339 (eggs/meat bait)	State labels and EUPs[b]	98% powder	3.5 g per site a.i.	twice/year per site
DRC-1339 (Starlicide Complete)	602-136	0.1% grain bait	50 lbs/acre	maximum of 3 days
Fenthion (BCF #1)	State label	9% solution	NA	once/year per site
Fenthion (Rid-a-Bird)	7579-2	11% solution	1 oz per perch	once/year per site
Mineral Oil	State EUP			
Glyphosate (Rodeo)	524-343	53.8%	198 oz/acre	once/year per site
Compound PA-14 (Tergitol) [c]	56228-13	99.50%	20 gal/acre of a.i.	twice/year per site
Polybutene (Eaton's 4 the Birds)	8254-1-56	paste (80% a.i.)	10.5 fl oz per 10 ft of roost	
Pigeon Bait Strychnine Corn[d]	56228-08	0.40%	5 qts per site	once/year
Strychnine (Sparrow Cracks) [d]	8612-30	grain bait (0.6%)		once/year
Strychnine Bird Toxicant [d]	9561-2	0.35%		once/year

(Continued)

States Where Used	Maximum Annual Use (A.I.)	Seasonal Use Distribution % by sp/su/f/w	Target Species or Species Group(s)	Resource(s) Protected	Representative Potential Nontarget Species
AL, CA, MI, NM, NV, OH, OK	100 grams	not fall	Canada geese, coots, ducks	HH&S, turf, nuisance	gulls, geese, house sparrow
HI, ID, KS, KY, NJ, NM, NC, OK, TN, TX, VT, WA, WV	1.4 lbs	all year	sparrow, pigeons, gulls, blackbirds, starlings	HH&S , livestock feed, property, cattle	mourning dove, savannah sparrow, eastern meadowlark
TN, KY	0.088 lb	all year	gulls	HH&S and property	none
AZ, GA, ID, MS, NM, NV, OR, UT, VT, WV, WA	115 lbs	0/20/40/40	starlings, blackbirds, pigeons, grackles, crows	apples, property, feedlots, HH&S, equipment	dark-eyed junco, mourning dove, blue jay, cardinal
IN, KY, GA, IL, NM, MI, TN	11.2 lbs	0/0/10/90	starlings, pigeons, crows	HH&S, property, grain, feed	mourning dove
LA, ND, TX	22 lbs	except summer	blackbirds, pigeons, grackles	sprouting rice, sunflowers, property, fruit	blue jay, dark-eyed junco, meadowlark, mourning dove
ME, MA	1.1 lbs	spring only	great black-backed and herring gulls	Arctic, common, and roseate terns	none
AZ, CA, ID, NM, NV, OR, UT	1.5 lbs	all year	raven, crows, magpies	livestock, endangered species, geese, grain, HH&S, waterfowl	opossum, raccoon, striped skunk, coyote
NJ, WA	1.17 lbs	fall and winter	starlings, blackbirds	cattle, feed, HH&S	cardinal, meadowlark
HI	0.09L	all year	mynah	HH&S	house finch
KY	0.9 gal	all year	pigeons	HH&S, property	house sparrow, house finch
WA	15 gal	100/0/0/0	gull, ring-billed	HH&S, property	none
ND, SD	355.6 gal	summer only	cattails for reducing blackbird habitat	sunflower	other wetland birds: American bittern, VA rail, wrens, sparrows
KY, MS, TN	715 gal	winter only	blackbirds, starlings	HH&S, property, resources	robin, dark-eyed junco, cardinal, sparrow, bobwhite, others in roost
HI	50.4 oz	25/25/25/25	pigeons	HH&S	none
LA, TX	0.24 lb	all year	pigeons	HH&S, equipment, property	domestic dog, great horned owl, gull, ducks, meadowlark
TX	0.03 lb	25/25/25/25	house sparrow	property, equipment	
TX	0.001 lb	100/0/0/0	grackle, blackbird	fruit, crops	

Table P-7(Continued)

Chemical Methods Used by APHIS ADC for Direct Control During FY 1988 through FY 1991–Specific Use Pattern Data

A.I./Product Name	Registration Numbers	Formulation	Maximum Application Rates	Maximum Application Frequency
Rodenticides				
Aluminum Phosphide (Phostoxin, Detia-Rotox, Fumitoxin)	40285-1, 2548-69, 5857-1	3 g tablet, 55% - 57%	4 tablets/burrow	twice/year per site
Brodifacoum (Weather Blok)	10182-48	0.005%	23 bloks/15 ft at 20 g/blok	continuous 15 days
Cholecalciferol (Quintox)	12455-39, and State EUP	0.075%	8 oz bait/15 ft	continuous 10 days
Sodium Nitrate (gas cartridge for rodents)	56228-2	43.36% 85 g/cart.	1 cartridge per burrow	
Strychnine (Strychnine milo)[d]	56228-11; 56228-19	0.35%	10 lbs/acre; 1 lb/acre	once/year
Strychnine (steam-rolled oats)[d]	56228-12; 56228-20	0.50%	10 lbs/acre; 1 lb/acre	once/year
Strychnine[d]	56228-27; State labels	1.6% paste	1 gal/16 lbs bait, 1 cup/placement	
Strychnine[d]	State labels	4.9% paste	16 g/quart bait (0.31% a.i.)	
Strychnine, 5.79%, salt block [d,e]	56228-04	5.79% wood block	1 block/tree	once/year
Zinc Phosphide Concentrate for Mouse Control	56228-6; State EUP	63% powder	4 g/quart bait	once/month
Zinc Phosphide Concentrate for Muskrat and Nutria Control	56228-9	63% powder	4.8 Kg (a.i.) per square mile	once/month
Zinc Phosphide Concentrate for Rat Control	56228-7	63% powder	4.5 g (a.i.) per lb. of bait	once/month
Zinc Phosphide on Steam-rolled Oats	56228-5,14,18 and State labels	2% oats	10 lbs/acre	1 application per year

(Continued)

States Where Used	Maximum Annual Use (A.I.)	Seasonal Use Distribution % by sp/su/f/w	Target Species or Species Group(s)	Resource(s) Protected	Representative Potential Nontarget Species
NE, NM, OK, OR, TX	450 lbs	all year	gopher, prairie dog, mole, squirrel, voles, marmots	rangeland, alfalfa, turf, field grain, dikes, property	cottontail rabbit, deer mice, other animals inhabiting burrows
HI (Am. Samoa)	0.002 lb	all year	Polynesian rat	green sea turtle, hawk bill turtle, marine birds	none
VT	0.021 lb	spring and summer	chipmunks, mice, squirrels	maple sap	rabbits, hares, skunks
CA, ID, IN, KY, LA, MN, ND, NE, NM, OH, OK, OR, TN, TX, WV	303 lbs	all year	ground squirrels, gophers, marmots, woodchucks, prairie dog	CA least tern, crops, turf, pastures, structures, HH&S	cottontail rabbit, deer mice, burrowing owl, other animals inhabiting burrows
NE, NM, OR, TX	3.1 lbs	all year	pocket gopher, ground squirrels	rangeland, grain, alfalfa, turf, fruit, property	blackbirds, horned lark, mourning dove, sparrows, bald eagle, coyote, domestic dog
NE, NM, OR	38.6 lbs	all year	prairie dog, gophers, ground squirrels	rangeland, crops, property, trees	short-eared owl
ID	0.1 lb	20/0/0/80	hares, jackrabbits	alfalfa, beans	deer mice, voles, deer
ID, WA	3.44 lbs	spring and summer	marmot, woodchucks	grains, beans, pasture, alfalfa, sugar beets, berries	deer mice, voles, deer
OR	0.81 lb		porcupine	standing trees	deer mouse, northern flying squirrel, chipmunk, rabbit
ID	2.52 lbs	spring only	marmots	beans, grains, sugar beets, alfalfa, pasture	deer mouse, voles, livestock
LA, TX, TN	0.2 lb	all year	nutrias, muskrats	lawn, dikes, turf, pets, natural resources	potential hazard to raccoon, beaver; secondary hazard: domestic dogs/cats
NE, NM, TX, VA, WV	0.9 lb	all year	black rats, Norway rats	HH&S, property, poultry, livestock feed	potential hazard: domestic animals, feral cats
NE, ND, NM, OK, VT	366 lbs	all year	prairie dogs, squirrels, mice, chipmunks	pasture, crops, alfalfa, turf, maple sap	cottontail rabbits, deer mice, horned lark, pheasant, turkey

Table P-7(Continued)

Chemical Methods Used by APHIS ADC for Direct Control During FY 1988 through FY 1991–Specific Use Pattern Data

A.I./Product Name	Registration Numbers	Formulation	Maximum Application Rates	Maximum Application Frequency
Zinc Phosphide (ZP Rodent Bait AG)	12455-17	2% oats	20 lbs/acre	1 application per year
Zinc Phosphide (D&H Formula Rodent Rid-R)	2393-185-41937	2% oats	10 lbs/acre	1 application per year
Zinc Phosphide (ZP Rodent Bait)	12455-18	2% pellets		1 application per year
Zinc Phosphide on Wheat	56228-3	1.82% wheat	10 lbs/acre	1 application per year
Predacides & Other Agents				
Bone Tar Oil (Magic Circle deer repellent)	4704-3	93.75%	2 gal/ 2 acre (perimeter)	3 times monthly
Sodium Cyanide (M-44 Cyanide Capsules)	56228-15	88.62% (0.91 g/cap)	10 M-44 per 100 acres	1 capsule/M-44 week
Sodium Fluoroacetate, Compound 1080 (livestock protection collar)	56228-22; 46779-1	1.04% liquid	30.4 g/collar	1 collar/acre/week [g]
Sodium Nitrate (gas cartridge for coyotes)	56228-21	65% a.i. at 240 g	1 cartridge/burrow	once per year
Immobilizations/euthanizing agents (Ketaset, Beuthanasia-D, and Rompun)			1 dose per animal	once/animal

[a] Based on personal communication with APHIS ADC State directors in OK and KY.

[b] Registration numbers for experimental use permits (EUPs) and "State labels" (State and local need registrations: FIFRA Section 24(c)) are provided in Appendix Q.

[c] USEPA registration of this product was canceled in 1992.

[d] All above-ground uses of strychnine were suspended in 1988. Above-ground strychnine uses reported in this table occurred prior to the suspension.

[e] USEPA registration of this product was voluntarily withdrawn by APHIS ADC in 1989.

[f] Maximum annual use is based on amount of NaCN in capsules shipped from Pocatello Supply Depot. The number of capsules actually used is smaller.

[g] Based upon assumed maximum 20 collars in 20-acre pasture. For different scenarios and use restrictions on collar numbers, see technical bulletin (Connolly 1991).

[h] This amount was actually released into the environment, based on lost or punctured collars.

States Where Used	Maximum Annual Use (A.I.)	Seasonal Use Distribution % by sp/su/f/w	Target Species or Species Group(s)	Resource(s) Protected	Representative Potential Nontarget Species
ND	0.04 lb	0/75/25/0	ground squirrels	grain crops	mammals; secondary hazard to domestic cats/dogs
OR	133.5 lbs	75/25/0/0	ground squirrels, pocket gophers, voles	ditches, pastures	mammals; secondary hazard to domestic cats/dogs
NM	11.9 lbs	75/25/0/0	kangaroo rat	pasture, dikes, buildings	
KY, OR, TN	19.7 lbs	all year	voles, house mice	HH&S, property, trees, fruit	
NH	0.117 g	0/100/0/0	white-tailed deer	trees	
AZ, CA, CO, ID, LA, MT, ND, NE, NM, NV, OR, OK, SD, TX, UT, WY, WA	220 lbs [f]	all year	coyote, red fox, gray fox, wild dog	livestock, poultry	badger, fox, ringtail cat, skunk, vulture, opossum, raccoon, black bear, bobcat
TX	0.05 lb [h]	20/35/30/15	coyote	sheep, goats	golden eagle, skunk, domestic dog, turkey vulture
CA, CO, ID, MT, ND, NE, NM, NV, OR, OK, TX, UT, WA, WY	1,114 lbs	spring and summer	coyote	livestock, poultry, geese, watermelons	potential hazard: other animals inhabiting active coyote den
NE, NH, TX	< 24 oz (15 uses)	all year	skunk, raccoon, ferret, black bear, opossums	HH&S, property	none

Although information to conduct the risk assessment was obtained from numerous sources, the following sections discuss the rationale and provide some detail concerning the sources. The major sources include registrant files and archives, the APHIS ADC State Director survey, product labels, the USEPA Office of Pesticide Programs (OPP) registration database, and the open scientific literature. All individual sources of information are included in bibliography, and key terms are defined in the glossary of terms.

3. Data Sources

a. Registrant Files and Archives

In complying with USEPA registration requirements discussed above, APHIS ADC is the primary registrant for many chemical control agents, and as such it serves as a key repository for information used in the risk assessment. Sources included reprint files maintained for published materials to which APHIS ADC personnel have contributed during recent or past years, personal files of APHIS ADC/Denver Wildlife Research Center (DWRC) scientists, and the registration archives. These sources, represented by the project bibliography, were examined for both general and formulation-specific information on APHIS ADC chemical methods. This information was in turn directly incorporated into the screening and risk assessment procedures. Key items of information from these sources were identified, summarized, and incorporated into the database for each pesticide. The chemicals for which the APHIS ADC program maintained registrations during FY 1988 through 1991 include alpha chloralose, DRC-1339, PA-14, strychnine, zinc phosphide, sodium nitrate, sodium cyanide, and Compound 1080.

b. APHIS ADC State Office Records

A questionnaire was sent to each APHIS ADC State Director to gather specified information on pesticide use by APHIS ADC personnel in each State, including quantity, frequency, and season of use; target and nontarget effects information; and other data useful for the risk assessment. State Directors were provided with a complete list of end-use formulations asked to state which were used for what purpose during FY 1988 through 1991. Responses to this item formed the basis for the detailed use-pattern data provided in Table P-7.

c. Product Labels

Product labels are another critical source of information for conducting the risk assessment, and they are available from both the USEPA registration process and State-specific requirements under Section 24(c) of FIFRA. While many of the 24(c) labels have been issued for DRC-1339, other State labels are available for fenthion, strychnine, zinc phosphide, and Compound 1080.

A major intent of FIFRA is to authorize USEPA to regulate the uses of pesticide. Such regulation is accomplished through restrictive labeling. Under FIFRA it is a violation to sell a pesticide with a label that does not meet USEPA standards or to use a pesticide in a manner inconsistent with its labeling. For example, USEPA can prevent the application of a pesticide near a lake or stream simply by requiring the manufacturer to list a prohibition against such use on the registered label. It was assumed for the risk assessment that such labeling restrictions are followed and that such restrictions are indeed protective. The risk assessment therefore focused on potential exposures not addressed by label specifications.

USEPA has the authority to classify pesticides as "restricted use" formulations where an environmental hazard may be present and, similarly, may issue experimental use permits for pesticides in order to develop data needed for registration of a new product. States

also may issue experimental use permits, subject to USEPA regulations. Examples of such restricted use formulations include mineral oil, cholecalciferol, and zinc phosphide used for specific purposes. Alpha chloralose is regulated under the U.S. Food and Drug Administration (USFDA) with USEPA registration pending.

d. USEPA and Other Sources

The USEPA OPP is an important source of information on pesticides because of its detailed registration requirements. To accomplish the reregistration of existing products under FIFRA requirements, USEPA has developed registration standards for individual compounds that meet specified requirements. Under this system, the registration standard document establishes regulatory policy for products containing the chemical covered by the standard and specifies safety, use, and labeling criteria imposed on products containing that ingredient. It also identifies gaps in key data on the active ingredient and sets deadlines for registrants to fill identified information gaps. Where registration standards or Position Documents (issued as part of the Agency Special Review) were available, they were used to satisfy data needs.

USEPA registration standards include information that was critical to conducting the risk assessment, especially that relating to environmental fate and toxicology. Other sources include USEPA online databases, providing information on environmental fate, toxicology, and registration information, most of which have been developed by USEPA.

A recent USEPA Section 7 Consultation document for pesticides, including some of the chemical methods used by APHIS ADC, was also consulted (USEPA 1991e). Key biological opinions issued by the USFWS for APHIS ADC formulations provided crucial information concerning potential exposures to vertebrate pesticides.

4. Risk Assessment Screening

a. Overview of Screening Process

This section provides an overview of the rationale and approach used to conduct the risk assessment screening for the various formulations of the compounds assessed. Figures P-2 and P-3 depict the flow scheme and decision process used to approach the risk assessment for the direct control products addressed as part of the EIS, including how screening contributes to the overall process. This section details the approach adopted for screening, which consisted of two steps:

- Each product was reviewed against four critical elements (see "questions" in Table P-8); any product definitively triggering all 4 elements was assessed as having potential hazard and passed to the next level of analysis-scoring. The products that did not require scoring were designated *no probable risk* and passed through to final documentation.
- The products to be scored were evaluated against four key information components or categories (Tables P-7, P-9, P-10, P-11); on the basis of the total score, a product was designated either *no probable risk* or requiring QRA.

Thus, the three types of outcome from the screening process are: (1) products are designated *no probable risk* based on critical element screening; (2) products are designated *no probable risk* based on total scores; and (3) a QRA is warranted based on total scores.

In order to determine whether QRA was warranted for an individual product, it was necessary to review substantial amounts of information for each product that would later be required for the risk assessment itself. This reduced the possibility of duplicative effort; all effort invested in the screening process was ultimately applied to the risk assessment.

Figure P-1 **Overview of APHIS ADC Direct Control Chemical Methods Risk Assessment**

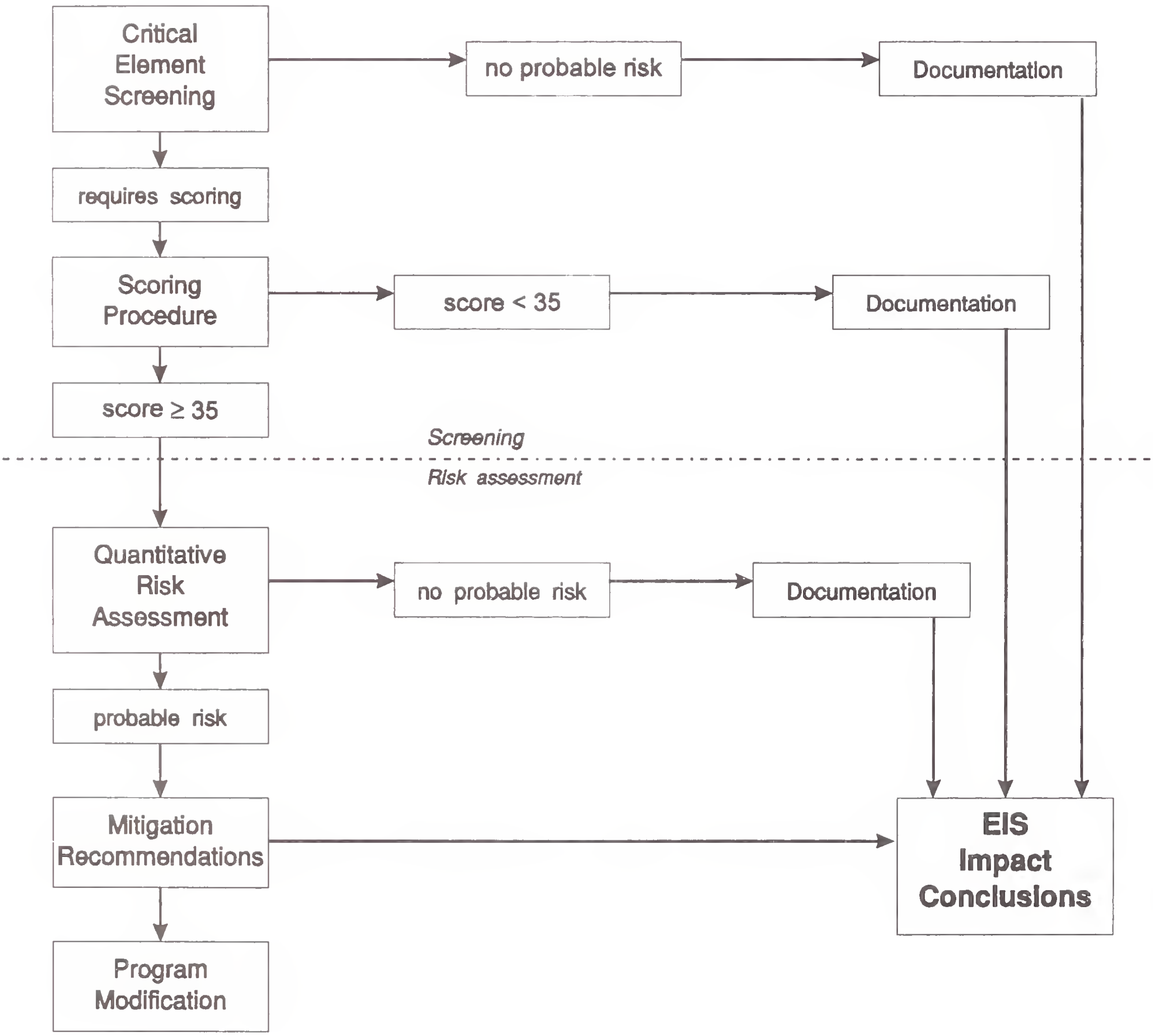

Figure P-2 **Quantitative Risk Assessment Process for APHIS ADC Direct Control Chemical Methods**

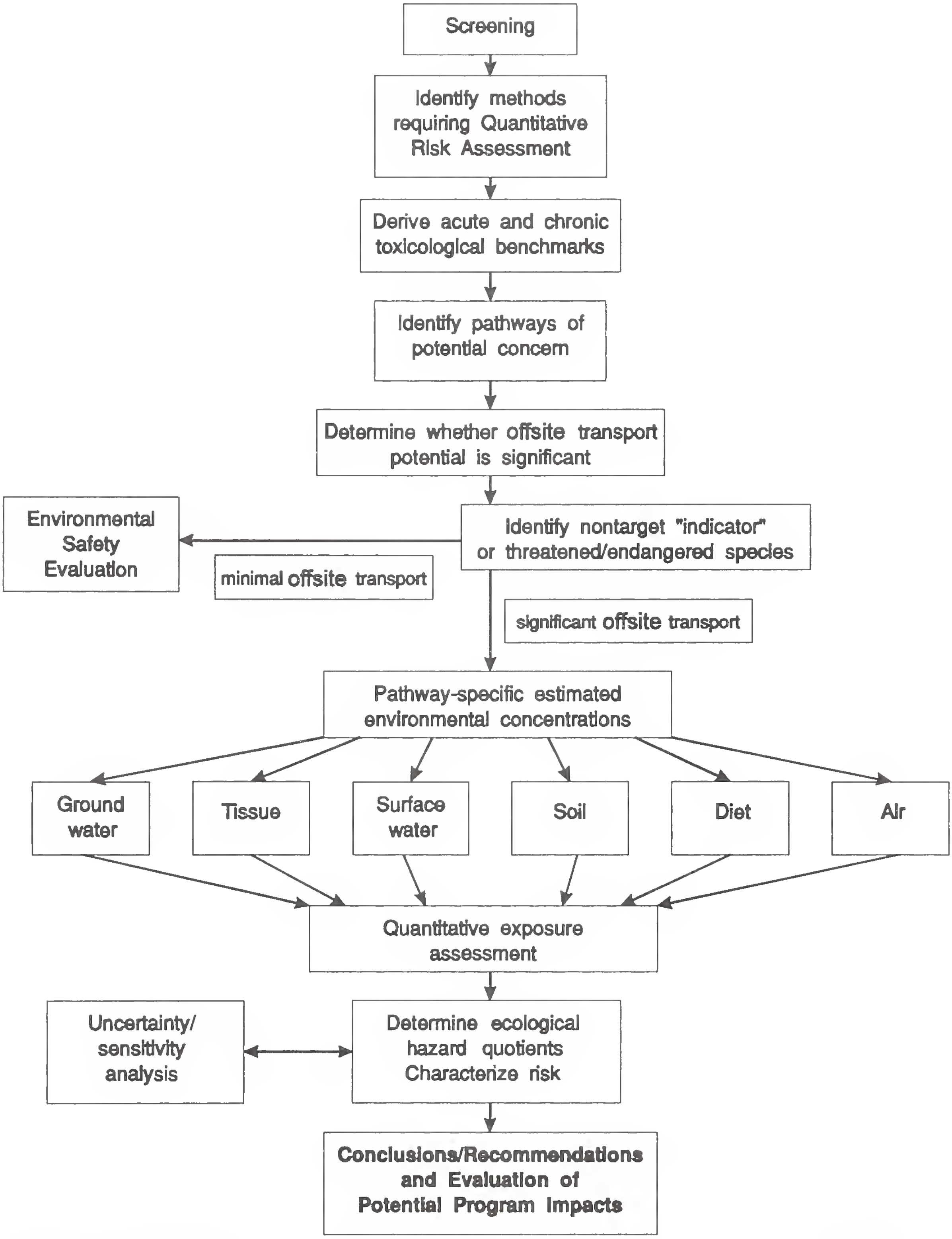

Figure P-3 **Decision Tree for Risk Assessment Screening of APHIS ADC Chemical Methods**

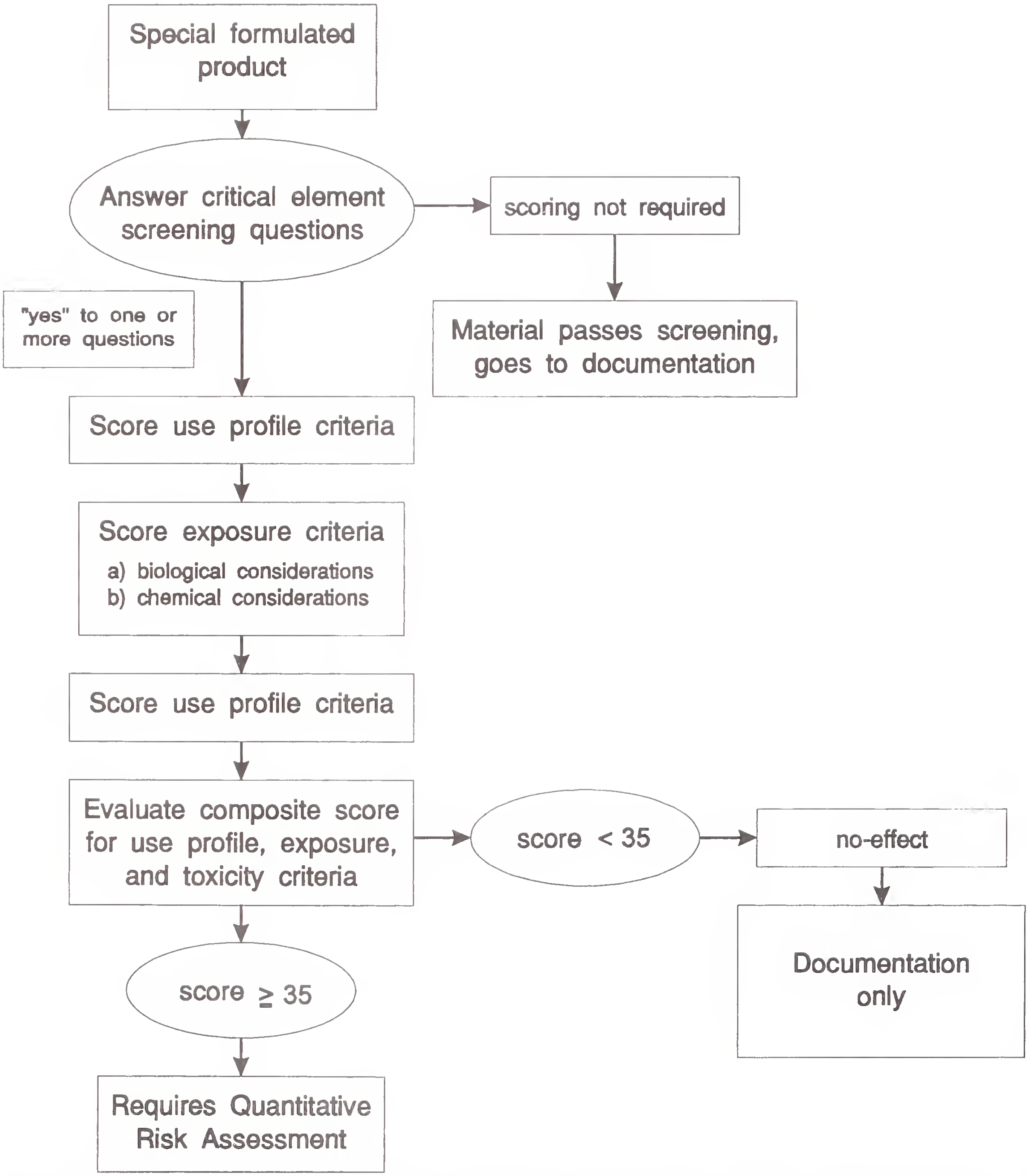

Table P-12 shows the overall results of both the critical element and scoring portions of the screening process: products were designated *no probable risk* based on critical element screening, 6 were designated *no probable risk* based on total scores, and 26 warranted QRA based on total scores. Table P-13 presents results for critical element screening only, including the basis for the designation. The following discussion outlines results obtained from the screening process.

b. Step 1: Critical Element Screening

In Step 1, four definitive triggers were used to determine whether a product was no probable risk or subject to further evaluation in step 2 (see Table P-8):

- Whether the active ingredient is nontoxic.
- Whether there are exposure pathways for nontarget receptors.
- Whether nontarget receptors may be potentially exposed.
- Whether label restrictions mitigate all potential exposures to nontarget receptors.

(1) Summary of Results: Critical Element Screening

Five of the 37 formulations subjected to critical element screening were eliminated from further consideration based on one or more of the critical elements described above. The five products designated as *no probable risk*, including the basis for designation, included:

- Mineral oil based on lack of toxicity.
- Polybutene based on lack of toxicity.
- Brodifacoum based on both lack of potentially exposed nontarget species and exposure pathways.
- Bone tar oil based on lack of toxicity.
- Tranquilizers/euthanizing agents based on both lack of potentially exposed nontarget species and exposure pathways.

In addition, each of these five products was deemed not to pose potentially unmitigated nontarget hazards (Table P-13). There is very little likelihood that any of these formulations, as used by APHIS ADC, could contribute to nontarget effects. Accordingly, they were eliminated from further consideration in the scoring portions of the screening process, detailed below.

c. Step 2: Scoring

The scoring procedure was designed to provide an objective basis for evaluating the potential for individual products to result in nontarget effects. The procedure was designed to address this potential relative to what is known of non-APHIS ADC toxic compounds and pesticides and relative to all other APHIS ADC chemical methods. Scoring categories were weighted by relative level of significance and scored as discussed below.

As indicated in Table P-8, two categories of information (nontarget receptors and pathways toxicity criteria) were weighted disproportionately to the other two categories (use pattern and chemical considerations), in an approximate 2:1 ratio. It was decided that nontarget receptors and pathways toxicity criteria were more critical to determine whether quantitative risk assessment was warranted. For example, if a compound is highly toxic or could cause effects to a threatened or endangered species, the score was weighted to push the product into QRA even if it is a product of minor use. Conversely, if a compound is mobile and widely used but nontoxic and does not threaten a T&E species, it will likely be designated as *no probable risk*.

Individual scores from all four of the scoring components were summed to produce a total score. This total score was then compared with a threshold value to determine whether quantitative risk assessment is warranted. The numerical threshold value was set at 35; that is, any total score of 35 or higher moved the product to QRA.

The threshold value was established in stages, consisting of:

- Retrospective comparison with all pesticides being evaluated as part of the APHIS ADC program (after the information had been compiled).
- Comparison with scoring procedures for risk assessments using other (non-APHIS ADC) pesticides or hazardous materials to determine the relative scale of APHIS ADC chemical method hazard potential.
- Interviews and discussions with numerous experts regarding potential nontarget risks associated with each product.
- Considering whether potential nontarget hazards exist, based on the weight of evidence and professional judgment.

Key examples of how the scoring process could effectively be applied to evaluate APHIS ADC products include fenthion and glyphosate, which are applied in high volumes by others but are used only to a minor extent by the APHIS ADC program. These materials are applied nationally by others for control of widely varying pests using variable applications, yet within the APHIS ADC program are applied in a highly specific manner with regard to:

- The target animal(s) controlled.
- Potentially exposed nontarget receptors.
- The formulations and mode of application used.
- The geographic extent of these materials.

Accordingly, both the use pattern or nontarget receptor components for these three products scored "low," and the resulting total scores reflect the relatively small amounts used by APHIS ADC on a national basis. Both the summary use pattern table (Table P-7) and the scoring process itself (Table P-14) are illustrative of this point. A discussion of each of the screening components follows. Key information categories evaluated for screening the end-use formulations are included in the discussions for each component.

(1) Use Pattern Components

The use pattern components were important because they provided key information regarding how, when, and where chemical methods are used and they contribute to the evaluation of other components, such as biological considerations in the exposure component. The weighting of use pattern information for purposes of screening, however, was relatively low (maximum score of 15). For example, if a certain formulation has a low application rate and limited use, exposures could still be significant if the material is highly mobile or toxic, even in small quantities.

The use pattern component for each product was a compilation of information about:

- Registration label use directions.
- Maximum application rates and frequency of application.
- States in which the compound was used by APHIS ADC during FY 1988 through 1991.
- Largest annual amount used by APHIS ADC in each State during FY 1988 through 1991.
- Seasonal distribution of use.

- Target species.
- Resource protected.
- Representative potential nontarget receptors.

Table P-7 summarizes this information and provides more detail concerning the use pattern of each product.

(2) Exposure Components

The two key elements of the exposure components in the scoring process included biological (nontarget receptors) and chemical considerations (environmental fate properties). These two elements of exposure were weighted differently relative to each other (total possible scores of 42 and 20, respectively, for biological and chemical considerations) to account for perceived disproportionate contribution to the overall exposure assessment. The emphasis of the risk assessment was to provide a conservative estimation of potential risk. The exposure assessment emphasized potentially affected receptors, such as T&E species or exposed humans, rather than environmental fate properties, because environmental fate properties contribute to potential exposure only in a generic sense. A more detailed discussion of these biological and chemical considerations follows.

(a) Wildlife and Human Nontarget Receptors

The purpose for conducting the chemical methods risk assessment is to address the potential for nontarget receptors (human or nonhuman) to be adversely affected as a result of APHIS ADC pesticide application. The component of nontarget receptors is therefore among the most important of all evaluated because it directly addresses the likelihood that an individual receptor could be present and exposed during the period of a specific pesticide application. Two of the critical elements considered earlier, exposure pathways and nontarget receptors, relate to this component.

The scoring of the nontarget receptors component focused on T&E species. The Endangered Species Act discourages taking of any listed species; therefore, this scoring component reflects a conservative evaluation of potential risk. Scores were weighted for listed species with specific reference to whether such exposures were potentially left unmitigated by label restrictions (prospective evaluation) in addition to existing data relating to impacts caused by past applications (retrospective evaluation). Table P-9 identifies T&E species considered. The list of species considered was developed from several sources, which are listed in the footnotes in Table P-9.

The scoring process necessitated a concise and focused analysis to determine if further investigation was required. Accordingly, nonlisted species and human receptors were considered in a retrospective manner (existing data) only, because a prospective consideration would require unnecessarily detailed consideration of numerous potential receptors. If further investigation was warranted, the subsequent analysis involved identifying potential nonlisted indicator species and conducting both retrospective and prospective evaluations similar to those conducted for T&E species, to determine whether hazardous exposures could occur. This process is discussed in much greater detail in the discussion of Identification of Indicator Wildlife Species of the quantitative risk assessment (see p. P-117).

(b) Environmental Fate

Environmental fate properties are important to the overall analysis because they are instrumental in determining the environmental behavior and ultimate fate of a compound following application and thus its exposure potential. These properties determine, for example, whether a compound would be expected to:

- Leach through soils to underlying groundwater.
- Be transported off-site via erosion or surface water runoff.

- Be sorbed to soil or sediment particles.
- Persist within a given environmental matrix and subsequently contribute to continuing exposures.
- Be taken up and accumulated within the tissues of plants or animals.

Table P-10 identifies key environmental fate characteristics for APHIS ADC compounds.

(3) Toxicity Component

Toxicity criteria were judged to be approximately as important as the biological component of the exposure criteria (nontarget receptor) evaluation, and therefore the two were weighted similarly for screening purposes (42 and 38, respectively). For example, even if identified exposures were minimal, hazardous impacts could still result if the product is highly toxic.

Evaluation of toxicological criteria is a complex process because it must take into account all possible receptors, both primary and secondary exposure, and variable exposure durations (acute, subchronic, chronic). For scoring purposes it was assumed that available information for each active ingredient would adequately represent potential formulation-specific exposures; that is, the inherent toxicity of the active ingredient was assumed to be the same for each formulated product.

For the purposes of scoring, chronic toxicity was weighted equally with acute toxicity. Secondary toxicity and human epidemiologic information, while sparse for most compounds, were also weighted approximately equally. Products found to warrant quantitative risk assessment, as a result of screening, were subjected to a more rigorous toxicological (dose-response) evaluation, including delineation of benchmark values used for quantitative risk assessment. Key toxicological information available for each active ingredient is provided in Table P-11.

(4) Summary of Results: Scoring

This section considers all categories of information scored, and provides a discussion of which formulated products could contribute to an adverse effect. As noted above, the parameters considered included use pattern components, potential nontarget receptors, environmental fate properties, and toxicological properties.

Table P-14 includes the summary sheets for all products scored. Each sheet provides the basic rationale for scores within each category, and is the basis for the discussion of specific products, which appears later in this assessment. Products with total scores of 35 or higher warranted QRA. Those falling below 35 were designated *no probable risk* and passed directly to documentation.

Table P-8 provides the information evaluated as part of the overall screening process. Tables P-12 and P-13 summarizes the results, and Table P-14 provides the detailed basis for numerical scoring.

Of the end-use formulations scored (Table-14), the following scored below 35 (i.e., *no probable risk* products) and do not require QRA:

- Alpha-chloralose
- DRC-1339 Gull Toxicant
- Glyphosate (Rodeo)
- Compound PA-14 (Tergitol), 99.5 percent
- Cholecalciferol (Quintox), 0.075 percent
- Zinc phosphide concentrate for Rat Control, 63 percent
- Zinc Phosphide Concentrate for Muskrat and Nutria Control, 63 percent

The end-use formulations that scored 35 or higher and therefore require *QRA* and further investigation include:

- 4-Aminopyridine (Avitrol), 0.5 percent (representative scenario).
- 4-Aminopyridine (Avitrol), 25 percent Concentrate.
- DRC-1339, 98 percent, feedlots; and Starlicide Complete, 0.1 percent.
- DRC-1339, 98 percent, structures.
- DRC-1339, 98 percent, staging areas (representative scenario).
- DRC-1339, 98 percent, eggs/meat bait.
- Fenthion (Rid-A-Bird), 11 percent; and (BCF#1), 9 percent.
- Aluminum phosphide (Fumitoxin, Phostoxin, Detia-Rotox), 55 percent or 57 percent.
- Sodium Nitrate (Gas Cartridge for Rodents, 43.36 percent).
- Strychnine (Pigeon Bait Strychnine Corn, 0.4 percent; Sparrow-cracks, 0.6 percent; and Bird Toxicant, 0.35 percent).
- Strychnine (Steam-Rolled Oats), 0.5 percent; (Milo), 0.35 percent (both above and below ground; representative scenario).
- Strychnine, 1.6 percent and 4.9 percent, paste.
- Strychnine, 5.79 percent, salt block.
- Zinc Phosphide Concentrate for Mouse Control, 63 percent.
- Zinc Phosphide, 2 percent ZP Rodent Bait AG (representative scenario), including D&H Formula Rodent Rid-R, Rodent Bait, Steam-Rolled Oats, 2 percent, and on Wheat, 1.82 percent.
- Sodium Nitrate (Gas Cartridge for Coyotes, 65 percent).
- Sodium Cyanide (M-44 Cyanide Capsules), 88.62 percent.
- Sodium fluoroacetate, Compound 1080, LP Collar.

5. Quantitative Risk Assessment Rationale and Methodology

a. Overview of Procedure

The purpose of the risk assessment is to evaluate the potential for nontarget effects to (human and nonhuman) receptors potentially exposed to APHIS ADC chemical methods applied according to label specifications. In order to accomplish this goal and to maximize its effectiveness, the risk assessment was designed to reduce uncertainty at each possible juncture. Specific objectives used to attain this goal included obtaining accurate and complete information for each product. A more systematic effort was made to supplement the information base previously developed to support the screening process. Figure P-3 depicts a flow scheme for the QRA leading to program recommendations and modifications. Major components included:

- **Exposure assessment.** To determine whether potentially significant nontarget exposures to products applied according to label specifications exist, the following analyses were conducted:
  - Consideration of key use pattern information, includes rates, frequency, locations, and modes of pesticide application.
  - Analysis of exposure pathways and environmental fate properties to determine the potential for significant off-site transport of each compound.
  - Identification of nontarget receptors, including nonlisted wildlife species, domestic animals, threatened or endangered species, and humans.
  - Development of quantitative exposure point concentrations to address nontarget exposures.
- **Toxicological assessment.** The toxicological characteristics of each compound were identified and compound-specific acute and chronic benchmarks derived based on the weight of toxicological evidence from the available data base.
- **Risk characterization.** Combined results of the exposure and toxicological assessments were used to characterize potential risks of each product. This involved:
  - Calculation of Hazard Quotient (HQ) values; and
  - Quantitative sensitivity/uncertainty analyses to identify key sources and relative magnitudes of uncertainty in the overall risk assessment.

The calculation and interpretation of HQ values requires special mention. HQ values are a measure of the potential hazard associated with a product. The HQ value is derived by dividing the potential exposure by the toxicity, where both are expressed as a dose. The resulting ratio can range from zero to very large numbers. The measure is used in this analysis to allow consistent assessments of potential hazard to be made, given the large number of products, target species, and nontarget species. In general, HQ values greater than one are interpreted to indicate that the product presents a hazard.

To ensure that the risk assessment was adequately conservative and based on a widely accepted time-tested approach, the USEPA Reasonable Maximum Exposure (RME) concept (USEPA 1989g) was adopted. This concept was developed specifically in support of quantitative exposure assessment, and consists of identifying the reasonable maximum exposure for each parameter considered in the risk assessment. In probabilistic terms this is expressed as the 95 percent level (i.e., on a cumulative probability distribution) wherever possible in the risk assessment. In other words, no attempt was made to identify the actual worst case scenario for the risk assessment, although selected parameters were designed to be highly conservative with respect to nontarget receptors. Statistical

distributions of input parameters could not always be determined, but the net effect of the RME approach on the risk assessment is to make it highly unlikely that actual exposures would exceed those addressed in the risk assessment.

The exposure assessment for end-use formulations that warrant QRA, as defined by the screening process, identifies potential exposure pathways associated with each formulation. This analysis distinguishes whether, for each product, off-site transport potential is likely to be minimal or significant. Environmental fate properties considered in making this determination are identified. Key habitats potentially affected by or of concern to chemical methods application and potentially exposed nontarget receptors (nonlisted wildlife species, domestic animals, threatened or endangered species, or humans) are then discussed. From this discussion, appropriate and representative indicator species are identified. Potential human receptors, such as residents, hunters, or workers inadvertently exposed to applied chemicals, are also identified.

The approach used here differs from the standardized approach for conducting pesticide risk assessments used by the USEPA OPP. The quantitative approach adopted for conducting the exposure assessment, including development of representative exposure scenarios, consists of an overview, a discussion of assumptions and modeling procedures, and a summary of the quantitative exposure assessment. The findings from the exposure assessment are combined with the toxicological benchmarks to characterize risk. Results of the sensitivity analysis, conducted as part of the exposure assessment, are presented in the uncertainty analysis.

The product-specific discussion provided later in this report includes a detailed summary of findings from the risk assessment and uncertainty analysis (or screening process, as applicable). This discussion also includes a comparison of findings from this risk assessment to biological assessments made pursuant to Section 7 of the Endangered Species Act (USEPA 1991b; and USFWS 1992).

b. Exposure Assessment

The exposure assessment is based on scenarios that define potentially exposed populations or individual organisms and that include frequencies and duration of potential exposures, complete exposure pathways, and concentrations of pesticides in diverse environmental media potentially contacting receptors through pathways delineated in the exposure scenarios. Exposures are typically evaluated by estimating the amount of a chemical entering a gastrointestinal or pulmonary tract or absorbed through the skin during a specified time duration. The exposure assessment includes:

- identification and characterization of exposure settings, including biological habitat and potentially exposed (human or nonhuman) organisms, communities, or populations;
- identification of exposure pathways, consisting of routes by which residues could be transported from a point of application to an "exposure point" to specified receptors over specified exposure durations;
- quantification of exposure point concentrations; and
- analysis of uncertainty in estimated exposures, often done by conducting sensitivity analyses of individual parameters within the analysis to determine which parameters contribute to greatest levels of uncertainty.

(1) Potential Exposure Pathways

This section addresses the potential exposure pathways for the 26 QRA products or product groups (Table P-12). One of the key considerations of this analysis is to classify these compounds according to whether the potential for off-site transport is minimal or significant for each compound. This is important because it is a crucial element in determining

whether nontarget exposures could be significant or cause an effect. For example, if there is a reasonable expectation that an acutely lethal fumigant such as aluminum phosphide or sodium nitrate would be both contained within the immediate area of application and would dissipate immediately after application, the compound would be classified as having minimal off-site transport potential. In other words, the sole means by which adverse nontarget effects could occur would be if a receptor were immediately present at the time and point of application.

The assumption in that case would be that controlling or restricting access by nontarget receptors to the fumigant (by checking burrows, restricting geographic areas, etc.) would provide an adequate means of mitigating nontarget effects. If the assumption holds that off-site transport is minimal, it therefore follows that a careful evaluation of the likelihood of presence of nontarget receptors from a particular site of application would be instrumental in providing recommended mitigation measures, such as labeling restrictions or specifications. The key assumption, consistent with labeling, is that exposure is both brief (acute) and lethal and that the primary consideration concerns the potential for exposure of nontarget vertebrates. Specific exposure pathways for each formulation are discussed later in the assessment.

In contrast, products that are toxic, persistent, or mobile are expected to have high off-site transport potential. It would not be adequate to simply evaluate the presence of nontarget receptors for these materials. Thus these products were taken through a more quantitative evaluation process as part of both the exposure and toxicological elements of the risk assessment. This analysis involves delineation of pathways, determination of indicator nontarget receptors, calculation of exposure point concentrations, and integration with toxicological benchmark values to produce a risk characterization.

The key potential exposure pathways for QRA products are based on: (1) use pattern, application mode, and restrictions (i.e., in addressing the potential for off-site transport); (2) compound-specific environmental fate properties, such as vapor pressure, half-life, solubility, and partitioning; (3) likelihood of precipitation or erosion potentially contributing to runoff or other off-site transport within the specific geographic areas of application; and (4) the presence of aquatic or terrestrial habitats near sites of application.

Potential exposure pathways for pesticides include: (1) direct ingestion; (2) dermal absorption; (3) ingestion of prey in which metabolized or unmetabolized pesticide residues are present, including potential bioaccumulation by the predator (representing either a primary or secondary exposure); (4) migration from the immediate point of application to adjoining surface soils; (5) potential leaching from surface soils to groundwater; and (6) potential off-site transport from the surface soil to adjoining surface water bodies via runoff or erosion.

Groundwater was considered as a potential pathway because of its potential for human exposures. Air transport was also considered as a potential pathway for each individual compound, especially with respect to potential air exposures associated with fumigants or other compounds for which the primary mode of action involved inhalation (e.g., M-44 sodium cyanide capsules). Based on these considerations the potential for airborne exposures was judged insignificant; no air modeling was warranted for the exposure assessment, in part because toxicants are released within burrows or other confined spaces or are subject to rapid dissipation. In either case, complex modeling of potential air transport exposures is not required.

(a) Pesticides With Minimal Off-Site Transport Potential

The compounds considered to exhibit minimal potential for off-site transport include fenthion, sodium nitrate (gas cartridges for rodents and coyotes), aluminum phosphide (fumigant for rodents), sodium cyanide (M-44 capsules), and sodium fluoroacetate (Compound 1080 Livestock Protection Collar). These compounds are all similar from the standpoint that both parent compounds and decomposition products are unlikely to migrate from the

immediate point of application. In the case of fumigants (sodium nitrate and aluminum phosphide), the toxic residues are assumed to remain confined within the target burrow(s), and the possibility of escape to the atmosphere or leaching to groundwater is not significant.

Sodium cyanide M-44 capsules and the 1080 Livestock Protection Collar release toxicant only when an individual animal makes contact with the device. The toxicant is then directly injected or released into the mouth of the predator with no significant residues remaining in the animal or environment. If there is no direct contact by nontarget organisms no other effects will be likely.

Accordingly, it was unnecessary to perform quantitative dose-response evaluations for most of these materials. If nontarget exposures occur (e.g., within burrows for fumigants or direct contact at the surface for the M-44 method), they were simply assumed to be lethal. Although sublethal exposures are possible, the assumption of lethality is more conservative and was therefore adopted. Fenthion and Compound 1080 were quantitatively addressed for both acute and chronic exposures, although no estimated soil or water concentrations were evaluated. Because contact was assumed to be lethal, no chronic exposures were addressed.

(b) Pesticides With Significant Off-Site Transport Potential

This section discusses products (subjected to QRA) believed to have significant potential for off-site transport. off-site pathways include: (1) potential for leaching to soils; (2) potential for leaching to groundwater; (3) potential for bioaccumulation following ingestion; and (4) potential for aquatic exposures within surface water. Specific types of data consulted in making these determinations included use pattern, environmental fate (e.g., sorption to soils, solubility, etc.), and other environmental (e.g., soil-specific, meteorological) effects. Neither toxicological nor nontarget receptor data were important in making this determination.

The active ingredients considered to have significant off-site transport potential include 4-aminopyridine, DRC-1339, strychnine, and zinc phosphide (Table P-15). These active ingredients are applied in many formulated products (end-use formulations). It may not be appropriate to consider strychnine and zinc phosphide on the basis of the active ingredient rather than formulated products because of different types of applications (e.g., strychnine is applied both above- and below-ground, and zinc phosphide may be applied in diverse ways.) The multiple formulations of DRC-1339 are applied on the ground and are therefore somewhat more amenable to generic consideration on the basis of the active ingredient. Modelling was used to determine the estimated environmental concentrations of these compounds for the risk characterization.

(c) Key Environmental Fate Properties

Environmental transport and fate processes affect chemicals released to the environment, leading to their gradual dispersion and depletion over time. Following application, some pesticides may be transported in soils, groundwater, or surface water; in the bulk movement of either a liquid phase or within contaminated soils or sediments; or within the atmosphere. As they are dispersed throughout the environment, these chemicals may be transformed or degraded through physical, chemical, or biological processes.

The release of pesticides to the various environmental media (e.g., to surface water) is largely controlled by aqueous solubility. However, soil particles bearing sorbed chemicals may also be transported by flowing water and eventually deposited as sediments. The release of chemicals from soil to groundwater may occur through diffusion or through leaching and percolation. In most instances, gases and vapors forming in the vadose zone, the unsaturated soil generally above the water table, are transported by diffusion to the surface, where they may escape into the atmosphere (USEPA 1989f).

Both diffusion and percolation through the soil column may be slowed by sorption of a contaminant to the surface of soil particles. Many organic compounds form a hydrophobic bond with the organic matter naturally present in soils (USEPA 1989f). Many inorganic compounds will likewise bond to mineral groups present at the surface of soil particles. The extent of sorption for most organic compounds can be reasonably estimated from the organic carbon content of the soil and the soil sorption coefficient, K_{oc}. Values of K_{oc} for critical chemicals used in the APHIS ADC program are given in Table P-16. Higher K_{oc} values reflect decreased mobility in the soil due to sorption.

Under equilibrium conditions, the distribution of a chemical between the soil and infiltrating groundwater can be estimated using a partition coefficient K_d, which may be derived using the formula $K_d = f_{oc}K_{oc}$ *where* f_{oc} is the fraction of organic carbon in the soil. K_d values measured in the field are frequently higher than calculated values because of nonequilibrium conditions in the environment.

The tendency for a substance to form a separate phase on contact with water is affected by its solubility, frequently represented by the octanol/water partition coefficient, K_{ow}. Chemicals with a high K_{ow} and a low solubility are likely to be immiscible with water, forming a separate, nonaqueous phase.

Chemicals released to the air or to soil, surface water, or sediments undergo a number of physical and chemical processes that may alter chemical makeup or chemical properties. In the atmosphere, volatile chemicals that are unreactive or only slightly reactive may have extremely long half-lives and may migrate to the stratosphere. Many compounds, however, will react with trace atmospheric constituents. A number of volatile organic compounds are prone to atmospheric reactions with radical chemical species that form through the action of sunlight. In particular, reaction with hydroxyl radicals present in the atmosphere is a likely fate of many volatile organic compounds. This reaction can occur to such an extent that other atmospheric reactions may be relatively insignificant.

Chemicals exposed to direct sunlight may also be degraded by photolysis. The decomposition of a compound through photolysis results from the absorption of ultraviolet radiation (Sax and Lewis 1987). The susceptibility of a compound to photolysis is directly proportional to its absorption maxima in ambient sunlight. Photolysis for key active ingredients is addressed as part of the exposure assessment.

Chemicals sorbed to soil particles may be effectively immobilized. However, changes in soil moisture content or chemistry can serve to release sorbed chemicals. With the exception of sorption, chemicals present in soil, surface water, and sediments are exposed to similar fate mechanisms. These mechanisms include chemical reactions, biotransformation, and bioaccumulation.

One type of acid-base reaction that can be important as a degradation process for certain organic chemicals is hydrolysis. The hydrolysis of a chlorinated compound produces an alcohol (USEPA 1989f).

Most clays consist of particles in the colloidal size range and are capable of participating in ion exchange reactions. Oxide minerals can also develop a charged layer in aqueous surroundings through dissociation reactions. An adsorbed layer of counter ions that balances the charged layer at the mineral surface may contain exchangeable ions. In both cases, the makeup of the charged layer and its ion-exchange activity is a function of pH (Freeze and Cherry 1979).

A number of biological processes occur in the subsurface, including biodegradation of organic compounds, nitrification and denitrification, oxidation and reduction of sulfur and iron, oxidation of manganese, and methane production (USEPA 1989f). Freeze and Cherry (1979) point out that groundwater systems tend to become depleted of oxygen due to hydrochemical reactions and to the activity of microorganisms. The loss of oxygen

gradually creates a reducing environment. Under these conditions, inorganic constituents may be reduced through reactions that are catalyzed by bacterial enzymes. These reactions oxidize organic matter and release energy for cell metabolism.

Bioaccumulation may also be considered a fate mechanism. A strong tendency to accumulate in living tissues is reflected in a high bioconcentration factor (BCF) value. The tendency for a compound to bioaccumulate is directly proportional to the logarithm of the octanol\water partition coefficient K_{ow}.

The evaporation of water from moist soil tends to promote the movement of volatile chemicals toward the soil surface through a phenomenon known as the wick effect. Evaporating water produces convection currents that can entrain trace chemicals, increasing their rate of transport through the soil. Soil moisture also tends to increase the effective vapor pressure of hydrophobic chemicals, thereby increasing their concentrations in the subsurface vapor phase and further driving the diffusion of chemicals toward the surface. The increased vapor pressure of organic chemicals in wet soil has been proven to result largely from displacement of chemicals from the surface of soil particles by water (Spencer et al. 1969).

Pesticide environmental fate properties are classified according to molecular type and by principal chemical substitute. In general, the transport and fate of pesticides in the environment is dominated by three processes: (1) airborne transport of vapors and particulates, (2) photochemical reactions, and (3) dry deposition and washout. Four categories of photochemical reactions that have been identified as important to pesticide fate are:

- Dechlorination reactions, frequently resulting in reduced toxicity.
- Photoisomerization reactions, which may form more stable and potentially more toxic isomers.
- Photooxidation reactions, which generally involve olefinic or aromatic structures of the pesticides.
- Photomineralization processes, which operate to convert chlorinated compounds to CO_2 and HCl.

Airborne particulates may play a role in catalyzing the photochemical reactions (Connell and Miller 1984). However, photochemical reactions will not be important factors in the environmental fate of such inorganic salts as sodium nitrate, sodium cyanide, or aluminum or zinc phosphide or in the fate of low molecular weight organic compounds, such as 4-aminopyridine.

The persistence of pesticides in the environment is related to their ability to sorb to native soils. The principal factors controlling sorption to soils include individual chemical characteristics, such as aqueous solubility. There is evidence that within a given chemical group, a direct relationship exists between the tendency of a pesticide to sorb to soils and sediment and its solubility in water. The above fate properties were investigated for the pesticide compounds and are discussed in the product-specific section that begins on page P-180.

(2) Habitats and Nontarget Receptors

Identification of nontarget receptors associated with QRA products is one of the key components of the overall risk assessment, because it addresses the likelihood that nontarget wildlife or human receptors would be present in a specific geographic area at the time of a pesticide application. Nontarget receptors consist of T&E species, nonlisted species, domestic animals, and even human receptors that could potentially be exposed to APHIS ADC chemical methods. If the label prescribed protective measures to be followed by the applicator, this was taken as adequate mitigation against unnecessary worker exposures. Similarly, if the label specified protective measures for T&E species, these measures were assumed to significantly reduce the exposure potential. The focus of the nontarget recep-

tor identification was therefore to consider potential T&E or other exposures not specified by pesticide labels but that could still reasonably occur within prescribed label limits. Table P-9 includes a detailed list of potential listed nontarget receptors by compound and formulation. The quantitative exposure assessment for end-use formulations for the QRA necessitated delineation of "indicator" species.

This section also identifies habitats where each of the end-use formulations that passed to scoring have been used during the past or can be used according to the labels. Knowledge of habitats is important for identifying nontarget receptors that potentially occur in habitats where compounds are applied.

(3) Potential Human Receptors

For the purposes of this risk assessment, potential human exposures to APHIS ADC chemical methods have been categorized into three basic exposure groups: **occupational** (defined as formulators, pest control operators, etc., both inside and outside of APHIS ADC), **recreational** (believed to include hikers, fishermen, hunters, and others potentially coming into contact with any of the methods) and **residential** consisting of farmers, ranchers, and gardeners).

The following discussion outlines the steps taken to evaluate the potential exposures of these groups to APHIS ADC chemical methods.

The underlying assumption in assessing potential human exposures is that APHIS ADC researchers and others have accumulated extensive experience and understanding of chemical methods used by APHIS ADC. Numerous professionals have studied nontarget hazards and potential for impacts associated with product use. The potential for human exposures was evaluated using existing reports, observations, and literature. It was not deemed necessary to conduct a quantitative exposure assessment for humans unless the review of available information indicated that such hazards could exist. This approach was retrospective in that it relied upon past observation rather than hypothetical quantification.

The major sources of information used in evaluating potential human exposures included:

- Personal consultation with APHIS ADC and other experts (e.g., DWRC scientists, APHIS ADC State Directors, etc.).
- Review of existing literature, articles, and reports published by APHIS ADC and others.
- Review of occupational hazard monitoring records maintained by the APHIS Management and Budget, Administrative Services Division and the safety records of personnel working at the Pocatello Supply Depot.
- The APHIS ADC State Director survey (questionnaire), designed in part for this purpose (see p. P-37).

In general, the review produced little evidence that there is much likelihood of hazardous exposure to potential human (occupational, recreational, residential) receptors, whether associated with field, laboratory, or factory work. This is not surprising because of the close supervision to which chemical method uses are subjected. It was therefore unnecessary to develop an RME scenario for health risk assessment using a quantitative approach. The quantitative portion of the exposure assessment more appropriately addresses nontarget wildlife exposures.

(a) Occupational

Although it is possible that worker exposure to pesticides could occur, USEPA-approved pesticide labels provide standard safety precautions to be taken prior to handling or applying these materials, consistent with Federal requirements under both FIFRA and the

Occupational Safety and Health Act (OSHA). Moreover, based on a review of the evidence, no hazardous exposures to workers are known to have occurred in association with formulating, handling, or application of these materials.

The review included evaluation of occupational hazard monitoring records maintained by the APHIS Management and Budget, Administrative Services Division, and Pocatello Supply Depot personnel records. This division of APHIS monitors health and safety for worker protection against exposures to pesticides at the Pocatello Supply Depot (PSD) (USDA 1987). The APHIS monitoring was conducted for workers associated with pesticide production processes. Findings from this personnel monitoring indicated no evidence of hazardous exposures exceeding the Threshold Limit Value (TLV) value when mixing zinc phosphide and strychnine concentrate with the binder (USDA 1987). Moreover, the eight-hour Time-Weighted Average (TWA) for zinc phosphide and strychnine did not exceed the TLV for either compound.

An interview of PSD management concerning personnel health and safety records over the past 15 years provided confirmation of the above findings; no evidence of adverse health effects is apparent from occupational exposures at PSD other than direct (i.e., physical) effects resulting from such accidents as burns from acid. As a result of monitoring, institutional controls for ventilation were installed to reduce short-term exceedence of TLV values or other standards (USDA 1987).

(b) Recreational or Residential

Recreational receptors include hikers, fishermen, hunters, or others who could potentially come into accidental contact with APHIS ADC chemical methods. It was assumed that such exposures would be more likely to occur in a rural setting, although some exposures could occur in an urban setting (e.g., controlling pest birds or rodents within parks). Existing literature indicated no evidence of hazardous exposures to rural or urban recreational receptors.

Residents potentially exposed to APHIS ADC control methods could include those requesting assistance from APHIS ADC or other residents who are uninvolved or unaware that control measures have been implemented. Residential exposures could occur with farmers, ranchers, gardeners, or other residents or neighbors, who could become exposed to any of the chemical pesticides.

(Text continued on p. P-117)

Table P-8

Procedure Used for Risk Assessment Screening of APHIS ADC Chemical Methods

"Critical element" questions

(1) Are there indications that the material is toxic to mammalian, avian, or aquatic species?

(2) Are there any apparent nontarget exposure pathways?

(3) Are there any nontarget species potentially exposed to the material?

(4) If label restrictions exist, do potentially unmitigated nontarget hazards remain?

If NO on any of the above, the material does not require scoring.

Scoring Criteria	**Scoring criteria and range ***
Use Pattern Component	
(1) States of use	1-9 States = 1; 10-25 States = 2; > 25 = 3
(2) Maximum annual use	</= 0.5 to 1 kg = 1; 1 to 3 kg = 2; 3 to 5 kg = 3; 5 to 10 kg = 4; >10 kg = 5
(3) Maximum labeled application rate (for a.i., in comparison to other program methods)	low = 1; medium = 3; high = 5
(4) Fraction of the year during which application could be made	1 to 2 quarters = 1; 3 to 4 quarters = 2
Total possible score = 15	
Exposure Component	
Nontarget receptors and pathways	
(1) Nontarget receptors (direct)	< 50 known nontarget kills = 1; 50-500 nontarget kills = 3; >500 nontarget kills = 6
(2) Nontarget receptors (indirect)	< 50 known nontarget kills = 1; 50-500 nontarget kills = 3; >500 nontarget kills = 6
(3) Threatened & endangered species	none = 0; threatened sp. mitigated by label or not expected but potentially exist = 2; threatened sp. unmitigated by label = 5; endangered sp. mitigated by label = 3; endangered sp. unmitigated by label = 15 (automatic QRA evaluation)
(4) Direct/indirect impacts (T&E spp.)	no impact= 0; potential= 1; indirect= 2; direct= 4
(5) Human receptors	no = 0; yes = 5
(6) Potentially sensitive ecosystems	no = 0; yes = 3
(7) Exposure pathways	1 route = 1; etc. (maximum of 5 pts.)
Total possible score = 42	
Chemical Component	
(8) Mobility (soil, water)	low = 1; moderately low = 2; moderate = 3; moderately high = 4; high = 5
(9) Persistence (soil, water)	low = 1; moderately low = 2; moderate = 3; moderately high= 4; high = 5
(10) Accumulation of residues between applications	no = 0; potential = 3; yes = 5
(11) Bioaccumulation in plant/animal tissue	none = 0; low = 1; moderately low = 2; moderate = 3; moderately high = 4; high = 5
Total possible score = 20	

(Continued)

Table P-8(Continued)

Procedure Used for Risk Assessment Screening of APHIS ADC Chemical Methods

Scoring Criteria	Scoring criteria and range *
Toxicity Component	
Acute	
(1) Human (epidemiologic)	none = 0; low = 3; moderate = 5
(2) Mammalian	LD_{50} > 2000 mg/kg = 0; LD_{50} 501 to 2000 mg/kg = 1; LD_{50} 51 to 500 mg/kg = 2; LD_{50} 10 to 50 mg/kg = 3; LD_{50} < 10 = 4
(3) Avian	LD_{50} > 2000 mg/kg = 0; LD_{50} 501 to 2000 mg/kg = 1; LD_{50} 51 to 500 mg/kg = 2; LD_{50} 10 to 50 mg/kg = 3; LD_{50} < 10 = 4
(4) Aquatic	LC_{50} > 100 mg/L = 0; LC_{50} 10 to 100 mg/L = 1; LC_{50} 1 to 10 = 2; LC50 0.1 to 1 = 3; LC_{50} < 0.1 = 4;
Chronic	
(5) Human (epidemiologic)	none = 0; low = 3; moderate = 5
(6) Mammalian	LD_{50} > 200 mg/kg = 0; LD_{50} 51 to 200 mg/kg = 1; LD_{50} 5.1 to 50 mg/kg = 2; LD_{50} 1 to 5 mg/kg = 3; LD_{50} < 1 = 4
(7) Avian	LD_{50} > 200 mg/kg = 0; LD_{50} 51 to 200 mg/kg = 1; LD_{50} 5.1 to 50 mg/kg = 2; LD_{50} 1 to 5 mg/kg = 3; LD_{50} < 1 = 4
(8) Aquatic	LC_{50} > 10 mg/L= 0; LC_{50} 1 to 10 mg/L= 1; LC_{50} 0.1 to 1= 2; LC_{50} 0.01 to 0.1= 3; LC_{50} < 0.01= 4;
Secondary	
(9) All species	low = 0; moderate = 2; high = 4
Total possible score = 38	
Total possible cumulative score = 115	

* Where data were lacking, the "average" value was used.

Table P-9

List of Potentially Affected Threatened and Endangered Species

Pesticide	Potentially Affected T&E Species	Status[a]	Type of Potential Hazard	Specific Label Mitigations	States Where Potential Effects May Occur [b]	References [c]
Avicides						
4-Aminopyridine (Avitrol), 0.5%						
	whooping crane	E	primary	no	TX, NM, ID, KS, OK	FWS 1979, FWS 1992
	Attwater's greater prairie chicken	E	primary	no	TX	FWS 1979
	Aleutian Canada goose	T	primary	no	WA	FWS 1979, FWS 1992
	northern aplomado falcon	E	secondary	no	TX	APHIS ADC 1990
	bald eagle	T&E	secondary	no	ID, KS, KY, NC, NJ, NM, OK, TX, VT, WA, WV	APHIS ADC 1990
	peregrine falcon	E	secondary	no	ID, KS, KY, NC, NJ, NM, OK, TX, VT, WA, WV	APHIS ADC 1990
DRC-1339, 98%, Feedlots; Starlicide Complete, 0.1%						
	Aleutian Canada goose	T	primary	no	WA, OR	FWS 1979
	whooping crane	E	primary	no	ID, NM, UT	FWS 1979, FWS 1992
	bald eagle	T&E	secondary	no	AZ, GA, ID, MS, NJ, NM, NV, OR, UT, VT, WA, WV	APHIS ADC 1990
	peregrine falcon	E	secondary	no	AZ, GA, ID, MS, NJ, NM, NV, OR, UT, VT, WA, WV	APHIS ADC 1990
DRC-1339, 98%, Structures						
	bald eagle	E	secondary	no	GA, IL, IN, KY, MI, TN	APHIS ADC 1990
	peregrine falcon	E	secondary	no	GA, IL, IN, KY, MI, TN	APHIS ADC 1990
DRC-1339, 98%, Staging Areas						
	Attwater's greater prairie chicken	E	primary	no	TX	D&M 1992
	whooping crane	E	primary	no	TX, ND	FWS 1992
	northern aplomado falcon	E	secondary	no	TX	APHIS ADC 1990
	bald eagle	E	secondary	no	TX, ND, LA	APHIS ADC 1990
	peregrine falcon	E	secondary	no	TX, ND, LA	APHIS ADC 1990
DRC-1339, 98%, Eggs/Meat Bait						
	California condor	E	primary	no	CA	D&M 1992
	bald eagle	T&E	primary	no	AZ, CA, ID, NM, NV, OR, UT	D&M 1992
	San Joaquin kit fox	E	primary	no	CA	D&M 1992
	grizzly bear	T	primary	no	ID	D&M 1992
	gray wolf	E	primary	no	ID, NM	D&M 1992
	jaguarundi	E	primary	no	AZ	D&M 1992
	ocelot	E	primary	no	AZ	D&M 1992
Fenthion (BCF#1), 9%, and (Rid-A-Bird), 11%						
	bald eagle	E	secondary	no	KY	APHIS ADC 1990
	peregrine falcon	E	secondary	no	KY	APHIS ADC 1990

(Continued)

Table P-9 (Continued)

List of Potentially Affected Threatened and Endangered Species

Pesticide	Potentially Affected T&E Species	Status[a]	Type of Potential Hazard	Specific Label Mitigations	States Where Potential Effects May Occur[b]	References[c]
Strychnine (Pigeon Bait Strychnine Corn, Sparrow Cracks, and bird toxicant)						
	Attwater's greater prairie chicken	E	primary	no	TX	FWS 1979
	whooping crane	E	primary	no	TX	APHIS ADC 1990
	northem aplomado falcon	E	secondary	no	TX	APHIS ADC 1990
	bald eagle	E	secondary	no	LA, TX	FWS 1992
	peregrine falcon	E	secondary	yes	LA, TX	FWS 1979, FWS 1988, APHIS ADC 1990, FWS 1992
	jaguarundi	E	secondary	no	TX	APHIS ADC 1990
	ocelot	E	secondary	no	TX	APHIS ADC 1990
	Louisiana black bear	T	secondary	no	LA, TX	D&M 1992
Rodenticides						
Aluminum Phosphide (Fumitoxin, Phostoxin, Detia-Rotox), 55% or 57%						
	New Mexican ridge-nosed rattlesnake	T	primary	no	NM	FWS 1989
	Mexican gray wolf	E	primary	no	NM	D&M 1992
Sodium Nitrate (gas cartridge for rodents), 43.36%						
	Fresno kangaroo rat	E	primary	no	CA	FWS 1992
	giant kangaroo rat	E	primary	no	CA	FWS 1992
	Morro Bay kangaroo rat	E	primary	no	CA	FWS 1992
	Stephens' kangaroo rat	E	primary	no	CA	D&M 1992
	Tipton kangaroo rat	E	primary	no	CA	FWS 1992
	salt marsh harvest mouse	E	primary	no	CA	FWS 1992
	Point Arena mountain beaver	E	primary	no	CA	D&M 1992
	black-footed ferret	E	primary	yes	ND, NE, NM, OK	FWS 1979, APHIS ADC 1990, FWS
	San Joaquin kit fox	E	primary	yes	CA	FWS 1979, FWS 1992
	gray wolf	T	primary	no	ID, MN, NM	D&M 1992
	New Mexican ridge-nosed rattlesnake	T	primary	no	NM	FWS 1989
	San Francisco garter snake	E	primary	no	CA	FWS 1992
	blunt-nosed leopard lizard	E	primary	yes	CA	FWS 1992
	island night lizard	T	primary	no	CA	EPA 1991
	gopher tortoise	T	primary	yes	LA	APHIS ADC 1990, FWS 1992
	desert tortoise	T	primary	yes (in Utah)	CA	FWS 1992

(Continued)

Table P-9 (Continued)

List of Potentially Affected Threatened and Endangered Species

Pesticide	Potentially Affected T&E Species	Status[a]	Type of Potential Hazard	Specific Label Mitigations	States Where Potential Effects May Occur [b]	References [c]
	Santa Cruz long-toed salamander	E	primary	no	CA	EPA 1991
Strychnine (Strychnine milo 0.35%, steam-rolled oats 0.5%), above-ground use						
	Aleutian Canada goose	T	primary	yes	OR	FWS 1979, FWS 1988, APHIS ADC 1990, FWS 1992
	whooping crane	E	primary	no	NE, NM	FWS 1979, FWS 1988, APHIS ADC 1990, FWS 1992
	gray wolf	E	secondary	yes	NM	FWS 1979, FWS 1988, APHIS ADC 1990, FWS 1992
	bald eagle	E	secondary	no	NE, NM, OR	FWS 1988, APHIS ADC 1990, FWS
	peregrine falcon	E	secondary	no	NE, NM, OR	D&M 1992
Strychnine (Strychnine milo, 0.35%, steam-rolled oats 0.5%), below-ground use						
	ocelot	E	secondary	no	TX	APHIS ADC 1990
	jaguarundi	E	secondary	no	TX	APHIS ADC 1990
	gray wolf	E	secondary	yes	NM	APHIS ADC 1990
	northern aplomado falcon	E	secondary	no	TX	APHIS ADC 1990
	bald eagle	T&E	secondary	no	NE, NM, OR, TX	APHIS ADC 1990
	peregrine falcon	E	secondary	no	NE, NM, OR, TX	D&M 1992
Strychnine, 1.6% paste, 4.9% paste						
	whooping crane	E	primary	no	ID	APHIS ADC 1990
	woodland caribou	E	primary	no	ID	D&M 1992
	bald eagle	T&E	secondary	no	ID, WA	FWS 1982, APHIS ADC 1990
	gray wolf	E	secondary	yes	ID, WA	FWS 1982, APHIS ADC 1990
	grizzly bear	T	secondary	yes	ID, WA	FWS 1982
	peregrine falcon	E	secondary	no	ID, WA	FWS 1982
Strychnine, 5.79%, salt block						
	bald eagle	T	secondary	no	OR	D&M 1992
	peregrine falcon	E	secondary	no	OR	D&M 1992
	northern spotted owl	T	secondary	no	OR	D&M 1992

(Continued)

Table P-9(Continued)

List of Potentially Affected Threatened and Endangered Species

Pesticide	Potentially Affected T&E Species	Status[a]	Type of Potential Hazard	Specific Label Mitigations	States Where Potential Effects May Occur [b]	References [c]
Zinc Phosphide Concentrate for Mouse Control, 63%						
	whooping crane	E	primary	no	ID	APHIS ADC 1990
	woodland caribou	E	primary	no	ID	D&M 1992
Zinc Phosphide (ZP Rodent Bait AG 2%, D&H Formula Rodent Rid-R 2%, ZP Rodent Bait 2%, 1.82% wheat)						
	whooping crane	E	primary	yes	ND, NE, NM, OK	FWS 1979, FWS 1981, APHIS ADC 1990, FWS 1992
	Aleutian Canada goose	T	primary	yes (in CA only)	OR	FWS 1979, FWS 1981, APHIS ADC 1990, FWS 1992
Predacides						
Sodium Cyanide (M-44 Cyanide Capsules), 88.62%)						
	California condor	E	primary	no	CA	APHIS ADC 1990, FWS 1992
	San Joaquin kit fox	E	primary	no	CA	FWS 1979, APHIS ADC 1990, FWS
	jaquarundi	E	primary	no	TX, AZ	APHIS ADC 1989, APHIS ADC 1990
	ocelot	E	primary	no	TX, AZ	APHIS ADC 1989, APHIS ADC 1990
	gray wolf	E	primary	no	WA, ID, MT, WY, NM	FWS 1979, APHIS ADC 1990, FWS
	grizzly bear	T	primary	no	WA, ID, MT, WY, NM	FWS 1979, APHIS ADC 1990, FWS
Sodium Fluoroacetate, Compound 1080 (livestock protection collar) 1.04%						
	ocelot	E	primary	no	TX	D&M 1992
	jaguarundi	E	primary	no	TX	D&M 1992
	bald eagle	E	primary	no	TX	FWS 1985, APHIS ADC 1990
Sodium Nitrate (gas cartridge for coyotes), 65%						
	San Joaquin kit fox	E	primary	yes	CA	FWS 1979, FWS 1992
	Utah prairie dog	T	primary	no	UT	FWS 1979
	gray wolf	E	primary	yes	NM, WY, WA, NV, MT	FWS 1979
	black-footed ferret	E	primary	no	WY, UT, MT, CO, ND	D&M 1992
	New Mexican ridge-nosed rattlesnake	T	primary	no	NM	FWS 1989
	blunt-nosed leopard lizard	E	primary	no	CA	FWS 1992
	desert tortoise	T	primary	no	CA, NV, UT	D&M 1992

(Continued)

Table P-9

List of Potentially Affected Threatened and Endangered Species

Pesticide	Potentially Affected T&E Species	Status[a]	Type of Potential Hazard	Specific Label Mitigations	States Where Potential Effects May Occur [b]	References [c]
	San Francisco garter snake	E	primary	no	CA	D&M 1992
	Wyoming toad	E	primary	no	WY	D&M 1992

[a] Status:
T = Threatened
E = Endangered
T&E = Threatened in some areas; endangered in other areas (bald eagle).

[b] Species occur in these States where APHIS ADC used the product during FY 1988 through FY1991.

[c] References:

APHIS ADC 1989: U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Animal Damage Control. 1989. Letter from State Director of APHIS ADC to Field Supervisor of FWS. Re: Request for consultation on potential effects of Texas APHIS ADC program activites on ocelot and jaguarundi. Dated December 12, 1989.

APHIS ADC 1990: U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Animal Damage Control. 1990. Animal Damage Control Program. Draft Environmental Impact Statement. APHIS DEIS 90-001.

D&M 1992: Dames & Moore. 1992. Threatened and Endangered Species Database on Excel. Compilation from Federal Register, field guides, and other sources on geographic distribution, habitat use, and diet of T&E birds, mammals, reptiles, and amphibians.

USEPA 1991: U.S. Environmental Protection Agency. 1991. Letter from EPA to FWS. Re: Request for formal Section 7 consultation on 31 pesticides. Dated February 26, 1991.

USFWS 1979: Department of the Interior, U.S. Fish and Wildlife Service. 1979. Letter from the Director of FWS to Chief of APHIS ADC. Re: Biological Opinion - Section 7 Consultation for the Animal Damage Control Program. Dated January 2, 1981.

USFWS 1982: Department of the Interior, U.S. Fish and Wildlife Service. 1982. Memorandum from Associate Director of Wildlife Resources to Associate Director of Federal Assistance. Re: Amendment to ADC Section 7 Consultation.

USFWS 1988: Department of the Interior, U.S. Fish and Wildlife Service. 1988. Memorandum from Deputy Regional Director (Region 6). Re: Reinitiation of Section 7 formal consultation on above ground uses of strychnine. Dated May 25, 1988.

USFWS 1989: Department of the Interior, U.S. Fish and Wildlife Service. 1989. Biological Opinion on Selected Pesticides - Dated June 14, 1989. Revised September 14, 1989. PB90-122664.

USFWS 1992: Department of the Interior, U.S. Fish and Wildlife Service. 1992. Draft Biological Opinion. Animal Damage Control Program. Dated July 28, 1992 (See Appendix F).

(Continued)

Table P-10

Environmental Fate Characteristics by Active Ingredient

Compound	Partitioning: Mobility (Soil, Water)	Partitioning: Bioaccumulation	Persistence (Soil, Water)
Avicides			
Alpha-chloralose	generally moderate (high solubility)	low	low
4-Aminopyridine	low: generally strongly adsorbed on soil colloids, although sorption is pH-dependent	no evidence in literature; rapidly metabolized by birds and others	high: $t_{1/2}$ = 3-22 months
DRC-1339	moderately high especially in coarse-textured soils due to high water solubility and low Koc	not likely; rapidly metabolized by birds	low; $t_{1/2}$ = <2 days
Fenthion	moderately low due to low water solubility and moderate Koc; Kd = 7.7-67	low to moderate based on Kow	low; $t_{1/2}$ = <1 day in nonsterilized silty loam
Glyphosate (Rodeo)	low due to high Koc; although solubility is high	not likely, but does translocate readily into foliage	moderate; $t_{1/2}$ = 30 days
Compound PA-14 (Tergitol)	moderately mobile; highly soluble, but adheres to organic surfaces, not soils; not pH-sensitive	not likely; efficiently degraded in all environments	low; $t_{1/2}$ = 4 days in water
Strychnine	moderately low due to moderate solubility and moderate Koc. As a pure alkaloid, may be adsorbed on clays or organic matter. Mobile in acid soils due to acid salty formation. Vertical soil movement determined to be minimal in experimental studies.	low	moderately low; $t_{1/2}$ = 7-28 days in water
Rodenticides			
Aluminum Phosphide	insoluble and immobile; converts to phosphine gas and ultimately to orthophosphate	does not accumulate in animal tissue	low; $t_{1/2}$ (as gas) = several days
Cholecalciferol	insoluble and probably immobile	no data available	no data available
Sodium Nitrate	high; readily soluble. Combustion or degradation of unused gas cartridges likely to result in oxides of carbon, nitrogen, phosphorus, and sulfur. All of these products likely to be used by soil microorganisms or enter their respective elemental cycles.	extremely unlikely	low; gas escapes to atmosphere. NO_3-N entering groundwater is likely to undergo degradation.
Strychnine	moderately low due to moderate solubility and moderate Koc (see above)	low	moderately low; $t_{1/2}$ = 7-28 days in water
Zinc Phosphide	insoluble and generally immobile. Under moist conditions in soil, zinc phosphide breaks down to PH_3, which is released into the atmosphere or converted to phosphates and zinc complexes.	does not accumulate in animal tissue	moderate to low; decomposes within 30 days. Phosphine gas is converted to harmless phosphates.

(Continued)

Table P-10 (Continued)

Environmental Fate Characteristics by Active Ingredient

Compound	Partitioning: Mobility (Soil, Water)	Partitioning: Bioaccumulation	Persistence (Soil, Water)
Predicides & Other Agents			
Sodium Cyanide (M-44s)	high, sodium cyanide is rapidly hydrolyzed to HCN gas by available soil moisture. Infiltrates through soil as sodium cyanide to groundwater where it is readily degraded by microorganisms or other mechanisms.	extremely unlikely; metabolized immediately	HCN readily degraded by microorganisms; half-life in surface water is 5 to 50 hr.
Sodium Fluoroacetate	appears high based on high solubility, but LP Collar limits release and leaching from upper soil layers hampered by potentially high adsorption to root or other plant tissues	unlikely due to high solubility, although data are absent	moderately high; slow degradation in soil by microorganisms, with toxicity substantially reduced within two weeks
Sodium Nitrate	high; readily soluble. Nitrate-nitrogen may be leached from soils to groundwater; nitrate eventually reaches nitrogen cycle. Under poor drainage and aeration, nitrate may be reduced to result in escape of NOx gases.	extremely unlikely	low; gas escapes to atmosphere. NO3-N entering groundwater is likely to undergo degradation.

Table P-11

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
4-Aminopyridine										
	Avian									
	American robin	LD_{50}	4.22	mg/kg						Schafer 1983
	bobwhite quail	LD_{50}	15	mg/kg						Schafer *et al.* 1973a
	bobwhite quail					NOEL	32 days	300 (21)	ppm (mg/kg-d)	Schafer 1970a
	chicken	LD_{50}	15-35	mg/kg						Deichman and Gerarde 1969 in Schafer *et al.* 1973a
	chicken					LC_{50}	40 days	18	mg/kg-d	Schafer 1983
	coturnix quail	LD_{50}	5.62	mg/kg	12					Schafer *et al.* 1975
	coturnix quail				48	NOEL	6 weeks	4.30	mg/kg-d	Schafer *et al.* 1975
	coturnix quail					LC_{50}	28 days	447 (49.17)	ppm (mg/kg-d)	Schafer *et al.* 1975
	coturnix quail					LC_{50}	28 days	479 (53)	ppm (mg/kg-d)	Schafer and Marking 1975
	scaled dove	LD_{50}	4+	mg/kg						Schafer 1983
	mourning dove					LOEL	28 days	316 (20)	ppm diet (mg/kg-d)	Schafer 1970a
	grackle	LD_{50}	1.78+	mg/kg						Schafer 1983
	magpie	LD_{50}	2.37	mg/kg						Schafer *et al.* 1973a
	mallard	LD_{50}	4.22	mg/kg						Schafer 1972
	mallard					LC_{50}	8 days	722 (29)	ppm (mg/kg-d)	Schafer 1983
	Am. kestrel	LD_{50}	5.6	mg/kg						Schafer *et al.* 1973a
	Am. kestrel					NOEL	45 days	6.05	mg/kg-d	Schafer 1970a
	starling	LD_{50}	4.9	mg/kg						Schafer 1970a
	starling					NOEL	25 days	1.80	mg/kg-d	Schafer 1970a
	weaver, sparrow	LD_{50}	1.78-	mg/kg						Shefte *et al.* 1982
	red bishop	LD_{50}	4.22	mg/kg						Shefte *et al.* 1982
	Mammalian									
	dog	LD_{50}	3.7-12	mg/kg						Schafer 1983
	beagle dog				8	NOEC	90 days	3	mg/kg-d	Schafer 1970a
	horse	LD_{50}	2.3	mg/kg						Schafer 1983
	pig	LD_{50}	4,500	mg/animal						Schafer 1983
	rat					edema	90 days	5	mg/kg-d	Schafer 1983
	rat	LD_{50}	20	mg/kg						
	human	LD_{50}	0.6	mg/kg						HSDB 1991a
	Aquatic									
	bluegill	96 hr LC_{50}	2.8-7.5	mg/L						Schafer and Marking 1975
	catfish	96 hr LC_{50}	2.4-5.8	mg/L						Schafer and Marking 1975
	crayfish	96 hr LC_{50}	2.2	mg/L						Marking and Chandler 1981

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
	fish	96 hr LC_{50}	1.4-400	mg/L						
	glass shrimp	96 hr LC_{50}	0.37	mg/L						Marking and Chandler 1981
DRC-1339										
	Avian									
	Am. kestrel	LD_{50}	>32	mg/kg	1					
	blackbird	oral LD_{50}	1.8-3.2	mg/kg	10					Decino and et al. 1966
	blue jay	LD_{50}	10	mg/kg	2					Decino and et al. 1966
	bobwhite quail	oral LD_{50}	4.2	mg/kg	4					Knittle 1989f
	bobwhite quail					LC_{50}	22 days	6.23	mg/kg-d	Schafer et al. 1970
	bobwhite quail					NOEL	21 days	1.47	mg/kg-d	Fletcher and Pedersen 1991a
	chicken	5 d LC_{50}	40 (2mg/kg-d)	ppm						Felsenstein et al. 1974
	chicken	LD_{28}	3	mg/kg	25					Anon. 1966
	coturnix quail					LOAEL		10	ppm (0.75mg/kg-d)	Schafer et al. 1977
	cooper hawk	LD_{50}	>320	mg/kg	4					Decino et al. 1966
	golden eagle	LD_{50}	>100	mg/kg	4					Schafer 1970a
	house sparrow	LD_{50}	>320	mg/kg	3					Decino et al. 1966
	Jap. quail	5 d. LC_{50}	23	ppm	78					Hill et al. 1975
	magpie	LD_{50}	5.6	mg/kg	4					Ford 1967
	mallard	oral LD_{50}	17.8	mg/kg	3					Knittle 1989f
	mallard				16	LC_{50}	14 days	7.50	mg/kg-d	Knittle 1989f
	marsh hawk	LD_{50}	100	mg/kg	2					Decino et al. 1966
	pigeon, common	LD_{50}	17.7	mg/kg						Knittle 1989f
	pigeon, common					LC_{50}	30 days	100	ppm (13mg/kg-d)	Schafer et al. 1977
	ring-necked pheasant	LD_{50}	5.9	mg/kg						Schafer et al. 1977
	ring-necked pheasant					LC_{50}	22 days	21.45	mg/kg-d	Schafer et al. 1970
	raven	LD_{50}	13.3	mg/kg	14					Schafer 1970a
	starling	oral LD_{50}	3.2-5.6	mg/kg	12					Ford 1967
	starling				6	LD_{50}	90 days	0.30	mg/kg-d	Schafer et al. 1970
	Mammalian									
	cat	LD_{50}	162	mg/kg						Felsenstein et al. 1974
	cattle	LD_{50}	>10	mg/kg						Schafer 1970b
	dog	LD_{50}	71	mg/kg						Schafer 1970b
	mouse	LD_{50}	1800	mg/kg						Purina Mills MSDS 1989b

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
	rat	LD_{50}	1170	mg/kg						Purina Mills MSDS 1989b
	sheep	LD_{50}	400	mg/kg	2					Purina Mills MSDS 1989b
	Aquatic									
	bluegill	96 hr LC_{50}	21-32	ppm						Schafer 1970b
	catfish	96 hr LC_{50}	24-38	ppm						Schafer 1970b
	crayfish	96 hr LC_{50}	15	mg/L						Marking and Chandler 1981
	daphnia	48 hr LC_{50}	1.6	mg/L						Marking and Chandler 1981
	rainbow trout	96 hr LC_{50}	5.3-8.2	ppm						Schafer 1970b
Fenthion										
	Avian									
	blackbird	LD_{50}	2.4	mg/kg						Schafer et al. 1973
	blackbird	derm. LD_{50}	1.8 - 3	mg/kg						Schafer et al. 1973; Schafer and Eschen, 1984
	blackbird	LD_{50}	1.69	mg/kg						Schafer *and Jacobsen 1983*
	chicken	LD_{50}	20-28	mg/kg						USEPA 1991m, label
	duck	derm. LD_{50}	44	mg/kg						USEPA 1991m
	finch, house	LD_{50}	10	mg/kg	10					label; Hudson et al. 1984
	Canada geese	LD_{50}	12	mg/kg	8					label; Hudson et al. 1984
	Am. kestrel	secon-dary lethality	10 (1)	ppm diet (mg/kg-d)						USEPA 1988b
	mallard	LD_{50}	5.94	mg/kg	12					USEPA 1988c; label; HSDB 1991c; Hudson et al. 1984
	mallard	5 d. LC_{50}	231 (9.24)	ppm diet (mg/kg-d)	54					USEPA 1988c; Hill et al. *1975*
	mallard				12	Min LD	30 days	0.50	mg/kg-d	Hudson et al. 1984
	mallard	derm. LD_{50}	44	mg/kg	8		24 hr			Hudson et al. 1984
	mourning dove	LD_{50}	2.5	mg/kg						USEPA 1988c; label
	pheasants	LD_{50}	17.8	mg/kg	12					Hudson et al. 1984
	pheasants	5 d. LC_{50}	202 (8.08)	ppm diet (mg/kg-d)	32					Hill et al. 1975
	pigeon	LD_{50}	1.8-4.6	mg/kg	12					USEPA 1991m; Hudson et al. 1984
	bobwhite quail	LD_{50}	<4.0	mg/kg	4					USEPA 1988c
	bobwhite quail	5 d. LC_{50}	30 (3.3)	ppm diet (mg/kg-d)	40					USEPA 1988c; Hudson et al. 1984; Hill, et al. 1975

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
	coturnix quail	LD_{50}	17.8	mg/kg						Schafer et al. 1982
	coturnix quail	LD_{50}	10.6	mg/kg	12					USEPA 1991m; label; Hudson et al. 1984
	sparrow, house	LD_{50}	22.7	mg/kg	20					label; Hudson et al. 1984
	sparrow, house	LD_{50}	5.6	mg/kg						Schafer et al. 1973b
	sparrow, house	derm. LD_{50}	2.4	mg/kg						Schafer et al. 1973b
	starling	LD_{50}	5.3-17.8	mg/kg						Schafer and Jacobsen 1983
	starling	derm LD_{50}	9.5	mg/kg						Schafer and Eschen 1984
	Mammalian									
	rat	LD_{50}	250	mg/kg						USEPA 1988b; Farm Chem. Handbook 1992
	rat	dermal LD_{50}	1680	mg/kg						USEPA 1988b
	rat	dermal LD_{50}	320	mg/kg						label
	rabbit	LD_{50}	150	mg/kg						USEPA 1991m
	mouse	LD_{50}	88.1	mg/kg						USEPA 1991m
	guinea pig	LD_{50}	260	mg/kg						USEPA 1991m
	mice					muta-genicity NOEL		10	mg/kg-d	USEPA 1988b
	dog					cholin-esterase inhibition	weeks	50 (1.75)	ppm (mg/kg-d)	USEPA 1988b
	rabbit					fetotox		1.00	mg/kg-d	USEPA 1988a
	Aquatic									
	cutthroat trout	LC_{50}	1.58	ppm						USEPA 1988a
	daphnia	EC50	0.8	ppb						Mayer and Ellersieck 1986
	fathead minnow	LC_{50}	3.2	ppm						USEPA 1988a
	lake trout	LC_{50}	1.9	ppm						Johnson and Finley 1980
	rainbow trout	LC_{50}	0.55	ppm						Mayer and Ellersieck 1986
	rainbow trout	LC_{50}	0.93	ppm	(46% a.i.)					Johnson and Finley 1980
	striped bass	LD_{50}	0.453	ppm						USEPA 1991e
Strychnine										
	Avian									
	blackbird	LD_{50}	3.98	mg/kg						Hegdal and Gatz 1977a
	bobwhite quail				25	NOEL	28 days	1,000 (90)	ppm diet (mg/kg-d)	Pedersen and Helsten 1992b
	golden eagle	LD_{50}	5	mg/kg	5					Hudson et al. 1984
	house finch	LD_{50}	5.6	mg/kg						USDA no date
	mallard	LD_{50}	3.1	mg/kg	91 total					USEPA 1980

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
	mallard				25	NOEL	28 days	75 (8.75)	ppm diet (mg/kg-d)	Pedersen and Helsten 1992a
	mourning dove	LD_{50}	8.7	mg/kg						USDA no date; Hegdal and Gatz 1977a
	mourning dove	LD_{50}	>5.12	mg/kg (sulfate)	9					Hudson et al. 1984
	pheasant, ring-necked	LD_{50}	27	mg/kg						
	pigeon	LD_{50}	7.7-21.3	mg/kg	12					Schafer and Eschen 1985; USEPA 1980; Hudson et al. 1984
	quail, Calif	LD_{50}	112-161	mg/kg	9					USDA no date; Hudson et al. 1984
	robin	LD_{50}	10	mg/kg						USEPA 1980
	sage grouse	LD_{50}	35-50	mg/kg						Ward *et al.* 1942
	sparrow	LD_{50}	4.18	mg/kg	20					USDA no date; Hudson et al. 1984
	starling	LD_{50}	5	mg/kg						USEPA 1980
	turkey	LD_{50}	50	mg/kg						USEPA 1980
	Mammalian									
	coyote	LD_{50}	0.7	mg/kg						USEPA 1980
	coyote				5	NOEL	5 days	1.44	mg/kg-d	Marsh et al. 1987
	desert kit fox	LD_{50}	0.75	mg/kg						Schitoskey 1975; USDA no date
	domestic ferret	LD_{50}	0.71	mg/kg						Savarie et al. 1985
	grizzly bear	lowest dose	0.33	mg/kg	(from desert kit fox study (Schitosky, 1975))					Barnes et al. 1985; Schitosky 1975
	ground squirrels	LD_{50}	3.6	mg/kg						Anthony *et al.* 1986
	horse	LD_{50}	2	mg/kg						USEPA, 1980
	human	NOEL	0.136	mg/kg						USEPA 1991k
	jackrabbit	LD_{50}	4.4	mg/kg						USDA no date
	mink, female	LD_{50}	0.6	mg/kg						Anthony et al. 1986
	muie deer	LD_{50}	17.0-24	mg/kg	5					USEPA 1980; Hudson et al. 1984
	pocket gopher	LD_{50}	8.3	mg/kg						USEPA 1980
	porcupine	LD_{50}	8.2	mg/kg						Anthony et al. 1986
	rat sp.	LD_{50}	3.7-14	mg/kg						USDA no date
	rats				12	LOEL	28 days	2.50	mg/kg-d	Seidl and Zbinden 1982
	Aquatic									
	bull frog	LD_{50}	2.21	mg/kg						USEPA 1980
	daphnia	EC50	1.7	mg/L						Forbis 1989
	bluegill	LC_{50}	0.87	mg/L						Dawson et al. 1977
	bluegill	LD_{50}	0.76	mg/L						Forbis 1989
	bluegill	NOEC	0.31	mg/L						Forbis 1989

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
	inland silverside	LC_{50}	0.95	mg/L						Dawson et al. 1977
	"median threshold limit"	MTL	0.1-1	mg/L						USEPA 1991k
Aluminum Phosphide										
	Avian	NA								
	Mammalian									
	rats	LD33	20-40	ppm inhal						HSDB 1991g
	rats	lethality	1	ppm inhal						HSDB 1991g
	human	IDLH	200	ppm inhal						HSDB 1991g
	human	TLV	2	ppm inhal						HSDB 1991g
	rat				30	NOEL	2 years	0.03	mg/kg-d	Hachenburg 1972
	Aquatic	NA								
Sodium Nitrate										
	Avian	NA								
	birds	LD_{50}	4 to 21	mg/kg						HSDB 1991n
	raptors	LD_{50}	4 to 8	mg/kg						HSDB 1991n
	gallinaceous	LD_{50}	9 to 21	mg/kg						HSDB 1991n
	Mammalian									
	cattle	min. lethal	650	mg/kg						HSDB 1991n; USEPA 1991g
	coyote	lethality	8	mg/kg						
	domestics	lethality	1.2-2.2	mg/kg						
	humans	lethality	500-5000	mg/kg						HSDB 1991n
	humans	NOEL	1	mg/m^3						HSDB 1991n
	mice					mod. effect	14 mo.	2,000 (340)	ppm (mg/kg-d)	HSDB 1991n
	rabbit	LD_{50}	2680	mg/kg						USEPA 1992b
	rabbit	derm LD_{50}	<2,000	mg/kg						USEPA 1991g
	rats	LD_{50}	3700	mg/kg	50					USEPA 1991g and Cerven 1990e
	rats				10	LOEL	14 mo.	4,000	mg/L	Chow et al. 1980
	rats				24	NOEL	16 weeks	400	mg/L	Chow et al. 1980
	sheep	LD100	220	mg/kg						HSDB 1991n
	sheep					NOEL	24 hours	220	mg/kg-d	HSDB 1991n
	Aquatic	NA								
	fish	LC_{50}	>50	ug/L						HSDB 1991n
	fish	chronic	7.9	ug/L						HSDB 1991n

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
Zinc Phosphide										
	Avian									
	chickens	lethality	7 to 30	mg/kg		dverse effects		below lethal dose		Matschke and LaVoie 1987
	geese	LD_{50}	7.5-8.8	mg/kg	(force fed)					Calif Dept. of Fish and Game 1962
	Canada geese	LD_{50}	12	mg/kg	16					Glahn and Lamper 1983
	Canada geese	MLD	8	mg/kg	16					Glahn and Lamper 1983
	golden eagle	LD_{50}	>20	mg/kg	2					Hudson et al. 1984
	gray partridge	LD_{50}	16	mg/kg						USEPA 1980
	horned lark	LD_{50}	47.2	mg/kg	9					Hudson et al. 1984
	mallards	5 d. LC_{50}	1285 (51.4)	ppm diet (mg/kg)	60					Weiss 1986; Hill et al. 1975
	mallards	LD_{50}	35.7	mg/kg	12					Hudson et al. 1984
	mourning dove	LD_{50}	34.3	mg/kg						Matschke and LaVoie 1987
	pheasants	LD_{50}	8.8-26.7	mg/kg						USEPA 1980; Hudson et al. 1984
	pheasants	LD_{50}	16.4	mg/kg	12					Hudson et al. 1984
	partridge	LD_{50}	26.7	mg/kg						Matschke and LaVoie 1987
	coturnix quail					reprod. effect	20 days	0.27	mg/kg-d	Matschke and LaVoie 1987
	CA quail	LD_{50}	13.5	mg/kg						USEPA 1980; Matschke and LaVoie 1987
	blackbird redwg	LD_{50}	24-237	mg/kg						Schafer et al. 1983
	sparrow	ALD	20-50	mg/kg						Matschke and LaVoie 1987
	Mammals									
	CA ground squirrel	LD_{50}	33.1	mg/kg						Matschke and LaVoie 1987
	carnivores	LD_{50}	40-50	mg/kg						USEPA 1980
	cat	ALD	40	mg/kg						Matschke and LaVoie 1987
	cats, rats, and guinea pigs	inh. poisoning (33 days)	5 (7)	ppm (mg/m^3)						Matschke and LaVoie 1987
	cow	LD_{50}	50	mg/kg						Matschke and LaVoie 1987
	deer mouse	ALD	42	mg/kg						Matschke and LaVoie 1987
	dog	ALD	40	mg/kg						Matschke and LaVoie 1987
	jackrabbit	LD_{50}	8.2	mg/kg						USEPA 1980
	kangaroo rat	ALD	8	mg/kg						Matschke and LaVoie 1987

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
	desert kit fox	LD_{50}	93	mg/kg						Schitoskey 1975; Matschke and LaVoie 1987
	nutria	LD_{50}	5.6	mg/kg						USEPA 1980; Matschke and LaVoie 1987
	pocket gopher	LD_{50}	6.8	mg/kg						USEPA 1980
	prairie dog	LD_{50}	18	mg/kg						Matschke and LaVoie 1987
	rat	LD_{50}	40	mg/kg						Weiss 1986
	rat				12	NOAEL	13 week	3.48	mg/kg-d	Bai et al. 1980
	rat					NOEL	2 yrs	1.00	mg/kg	Matschke and LaVoie 1987
	rodents	LD_{50}	15-40	mg/kg						USEPA 1980
	sheep	lethality	60-70	mg/kg						Matschke and LaVoie 1987
	Aquatic									
	bluegill	LC_{50}	0.8-1.48	ppm						Matschke and LaVoie 1987 ; Hood 1972; Bell Labs 1992, pers. comm.
	bluegill	LC_{50}	0.062	mg/L						Harkins 1987a
	bullhead	LC_{50}	0.44	mg/L						Matschke and LaVoie 1987 ; Hood 1972
	carp	LC_{50}	0.285	mg/L						Matschke and LaVoie 1987 ; Hood, 1972
	catfish	LC_{50}	0.542	mg/L						Matschke and LaVoie 1987 ; Hood, 1972
	crayfish	4 d lethality	50	mg/L						Matschke and LaVoie 1987
	daphnia	LD_{50}	0.23	mg/L						Bell Labs 1992 pers. comm.
	goldfish	4 d lethality	>10	mg/L						Matschke and LaVoie 1987
	rainbow trout	LC_{50}	0.45-0.65	mg/L						Matschke and LaVoie 1987 ; Hood 1972; Bell Labs 1992, pers. comm.
	rainbow trout	LC_{50}	0.14	mg/L						Harkins 1987b
	rivershrimp	4 d lethality	<2	mg/L						Matschke and LaVoie 1987
	yellow perch	LC_{50}	0.622	mg/L						Matschke and LaVoie 1987 ; Hood 1972
	freshwater fish	final chronic value	0.058 mg/L							USEPA 1987b

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
Sodium Cyanide										
	Avian									
	black vulture	LD_{50}	4.8	mg/kg						Wiemeyer et al. 1986; HSDB 1991l
	chicken	LD_{50}	21	mg/kg						Wiemeyer et al. 1986; HSDB 1991l
	kestrel, Am.	LD_{50}	4	mg/kg						Wiemeyer et al. 1986; HSDB 1991l
	pigeon	LD_{50}	4	mg/kg (iv)						USFWS 1973
	quail, Jap.	LD_{50}	9.4	mg/kg						Wiemeyer et al. 1986; HSDB 1991l
	screech owl	LD_{50}	8.6	mg/kg						Wiemeyer et al. 1986; HSDB 1991l
	starling	LD_{50}	17	mg/kg						Wiemeyer et al. 1986; HSDB 1991l
	Mammals									
	cat	lethality	1.2	mg/kg						HSDB 1991l
	cattle/sheep	LD_{50}	2.0-3.0	mg/kg						Matheny 1976
	coyote	LD_{50}	4.1	mg/kg						Savarie 1977
	dogs	lethality	2.25	mg/kg						HSDB 1991l
	human	Min LD	200/70	mg/kg						Matheny 1976
	human					PEL		5	mg/m^3	USFWS 1984
	mouse	LD_{50}	10	mg/kg						USFWS 1973
	opossum	LD_{50}	8.86	mg/kg						Bell 1972
	rabbit	LD_{50}	2.2	mg/kg		(subcutaneous)				USFWS 1973
	rat	LD_{50}	10 to 15	mg/kg						USFWS 1973; Smith et al. 1969
	rat				10	NOAEL	2 year	20	mg/kg-d	Howard and Hanzal 1955
	Aquatic									
	freshwater fish	LC_{50}	0.01-0.2	mg/L						HSDB 1991l
	freshwater fish						2 life cycle	7.9-16	ug/L	HSDB 1991l
	frog	LD_{50}	60-65							Hudson et al. 1984
	minnows	24 hr LD_{50}	0.75	ppm						McKee and Wolf 1963 cited in USFWS 1975a
	trout	124 LD100	0.05	ppm						McKee and Wolf 1963 cited in USFWS 1975a
	goldfish	5 hr LD100	1	ppm						Bridges 1958 cited in USFWS 1975a
	green sunfish	4 hr LD100	0.5	ppm						Bridges 1958 cited in USFWS 1975a
	carp	5 hr LD100	1	ppm						Bridges 1958 cited in USFWS 1975a

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
Sodium Fluoroacetate										
	Avian									
	blackbird	LD_{50}	4.22	mg/kg						Schafer et al. 1983
	chicken	LD_{50}	7.5	mg/kg						Atzert 1971
	mourning dove	LD_{50}	8.55-14.6	mg/kg	13					Atzert 1971
	golden eagle	LD_{50}	1.25-5	mg/kg	6					USEPA 1980; Hudson *et al.* 1984
	golden eagle	LD_{50}	3.54	mg/kg	6					Hudson et al. 1984
	hawk sp.	LD_{50}	10	mg/kg						USEPA 1980
	house sparrow	LD_{50}	3	mg/kg	12					USEPA 1980; Godfrey 1986; Hudson et al. 1984; Atzert 1971
	magpie	LD_{50}	0.6-1.8	mg/kg						USEPA 1980; Burns et al. 1984b
	mallard				6	EMLD	30 days	0.50	mg/kg-d	USEPA 1980; Hudson et al. 1984
	mallard	LD_{50}	9.11	mg/kg						Hudson et al. 1984; Atzert 1971
	mallard duckling	LD_{50}	5.97	mg/kg						Hudson *et al.* 1984
	pheasant	LD_{50}	6.46	mg/kg	12					Godfrey 1986; Hudson et al. 1984
	pigeon	LD_{50}	4.24	mg/kg	12					USEPA 1980; Hudson et al. 1984; and Atzert 1971
	CA quail	LD_{50}	4.63	mg/kg	12					USEPA 1980
	starling	LD_{50}	2.37	mg/kg						Schafer et. al. 1983
	starling	5 d LC_{50}	47 (5.9)	ppm (mg/kg)	6					Balcomb et al. 1983
	turkey	LD_{50}	4-4.8	mg/kg	10					Hudson et al. 1984; Atzert 1971
	vultures, black; turkey	LD_{50}	15-20	mg/kg						Ward and Spenser 1947; USEPA 1980
	waterfowl	LD_{50}	3.0-15	mg/kg						USEPA 1980
	Mammals									
	blackbear	LD_{50}	0.5-10	mg/kg						USEPA 1980
	bobcat	LD_{50}	0.66	mg/kg						USEPA 1980; Atzert 1971
	brown bat	LD_{50}	0.15	mg/kg						USEPA 1980
	cow	LD_{50}	0.22	mg/kg						Atzert 1971
	coyote	LD_{50}	0.12	mg/kg						Marsh et al. 1987
	coyote				6	adverse effects	5 d	0.055	mg/kg-d	Marsh et al. 1987
	mule deer	LD_{50}	0.3-1	mg/kg	6					USEPA 1980; Hudson et al. 1984
	domestic ferret	LD_{50}	1.41	mg/kg	8					USEPA 1980; Hudson et al. 1984

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
	domestic ferret	secondary lethality	1 to 2	mg/kg	5					Hudson *et al.* 1984
	desert kit fox	LD_{50}	0.22	mg/kg						Schitoskey 1975; USEPA 1980
	ground squirrel	LD_{50}	0.35	mg/kg						USEPA 1980
	jackrabbit	LD_{50}	5.55	mg/kg						Atzert 1971
	nutria	LD_{50}	0.065	mg/kg						USEPA 1980
	prairie dogs	LD_{50}	0.3-0.9	mg/kg						USEPA 1980
	rabbits	LD_{50}	0.4	mg/kg						Godfrey 1986
	sheep	LD_{50}	0.25-0.5	mg/kg						Atzert 1971
	skunk	secondary lethality	165/13	mg/kg coyote						Eastland and Beasom 1986; Burt and Grossenhaider 1980; Walker, et al. 1975
	skunk	LD_{50}	0.35	mg/kg						Burns et al. 1984a
	Aquatic									
	bull frog	LD_{50}	54.4	mg/kg						Hudson et al. 1984
Alpha-chloralose										
	Avian									
	blackbird	LD_{50}	32	mg/kg						USDA 1989d
	chicken	LD_{50}	300	mg/kg						USEPA 1992d
	coots	LD_{50}	>60	mg/kg						Woronecki et al. 1990
	crow	LD_{50}	70-90	mg/kg						USDA 1989d
	domestic ducks	LD_{50}	50-60	mg/kg						Woronecki et al. 1990
	Canada geese	LD_{50}	53.9	mg/kg						Woronecki et al. 1992
	geese, greylag	LD_{50}	>775	mg/kg						Woronecki et al. 1990
	grackel	LD_{50}	75	mg/kg						USDA 1989d
	mallard	LD_{50}	42	mg/kg						Woronecki et al. 1990
	mourning dove	LD_{50}	42	mg/kg						USDA 1989d
	partridge, grey	LD_{50}	100-125	mg/kg						USDA 1989d
	pheasant, ring-necked	LD_{50}	100-400	mg/kg						USDA 1989d
	pigeon	LD_{50}	215	mg/kg						Woronecki, et al. 1992
	quail	LD_{50}	31600	mg/kg						USEPA 1992d
	sparrow, house	LD_{50}	42	mg/kg						USDA 1989d
	starling	LD_{50}	75	mg/kg						USDA 1989d
	Mammalian									
	cat	LD_{50}	250	mg/kg						USEPA 1992d
	cat	LD_{50}	600	mg/kg						USDA 1989d
	dog	LD_{50}	175	mg/kg						USEPA 1992d
	dog	LD_{50}	600	mg/kg						USDA 1989d
	rat	LD_{50}	200	mg/kg						USDA 1989d

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
	Aquatic									
	goldfish, Koi	44 hr lethality	(30 mg/bread cube thrown in pond)							Woronecki et al. 1990
PA-14										
	Avian									
	blackbird, rdwg	LD_{50} (oral)	0.9	ml/kg						USFWS 1976b, label
	blackbird, rdwg	LD_{50} (dermal)	19.9	ml/kg						USFWS 1976b, label
	am kestrel	LD_{50}	6300	mg/kg						Tergitol label; USFWS 1976b
	starlings	LD_{50}	>1,000	mg/kg						Schafer 1991a
	blackbirds	LD_{50}	>100	mg/kg						Schafer 1991a
	mallard	LD_{50}	>2,000	mg/kg						Hudson et al. 1984
	Mammalian									
	dog					LOEL	3 months	350	mg/kg	USFWS 1976b; PA-14 label
	general	dermal LD_{50}	>200	mg/kg						USFWS 1976b
	guinea pig	LD_{50}	650	mg/kg						USEPA 1992a
	guinea pig	dermal LD_{50}	650	mg/kg						USEPA 1992a
	rabbit	dermal LD_{50}	1.1	ml/kg	5					USDA 1990c
	rabbit	dermal LD_{50}	2000	mg/kg						USFWS 1976b
	rat	LD_{50}	1250	mg/kg						USEPA 1992a
	rat, female	LC_{50}	4	ml/kg	5					USDA 1990c
	rat					NOEL	3 months	830	mg/kg	USFWS 1976b
	Aquatic									
	bluegill	96 hr LC_{50}	4.8	mg/L						Macek and Krzeminski 1975; USEPA 1992f
	bluegill	96 hr LC_{50}	1.4	mg/L						Marking and Chandler 1981
	grass shrimp	96 hr LC_{50}	6.1-10.8	mg/L						Marking and Chandler 1981; USEPA 1992f
	glass shrimp	96 hr LC_{50}	1.7	mg/L						Marking and Chandler 1981
	crayfish	96 hr LC_{50}	15	mg/L						Marking and Chandler 1981; USEPA 1992f
	crayfish	96 hr LC_{50}	44	mg/L						Marking and Chandler 1981
	catfish, channel	96 hr LC_{50}	3 to 6	mg/L						Lefebvre and Seubert 1970
	bluegill	96 hr LC_{50}	5 to 7	mg/L						Lefebvre and Seubert 1970

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
	daphnia	96 hr LC_{50}	3	mg/L						Lefebvre and Seubert 1970
Glyphosate										
	Avian									
	quail	LD_{50}	>3,850	mg/kg						USEPA 1991 l
	Mammalian									
	dogs					NOEL	2 yr. feed	500	mg/kg-d	USDA 1988 (FEIS)
	dogs and rats					NOAEL	2 yr. feed		ppm (mg/kg-d)	HSDB 1991e
	goat	LD_{50}	5700	mg/kg						Monsanto 1990
	heifers					NOEL	7 days	540	mg/kg-d	Monsanto 1990
	mouse	LD_{50}	1568	mg/kg						USEPA 1991n
	mouse					oncog. NOEL	2 year	750	mg/kg-d	USDA 1988 (FEIS)
	rabbit	LD_{50}	4,400	mg/kg						Monsanto 1990 and USEPA 1991n
	rabbit	dermal LD_{50}	7940	mg/kg						USEPA 1991n
	rat	LD_{50}	4,320	mg/kg						USDA 1988 (FEIS)
	rat					NOEL	26 mo.	31	mg/kg-d	USDA 1988 (FEIS)
	rat					fetotox NOEL	3 gen.	10	mg/kg-d	USDA 1988 (FEIS)
	Aquatic									
	bluegill	96 hr LC_{50}	160	mg/L						Mayer and Ellersieck 1986
	bluegill	96 hr LC_{50}	135	mg/L						Johnson and Finley 1980
	bluegill	96 hr LC_{50}	5.6	mg/L	(41% Roundup)					Johnson and Finley 1980
	catfish, channel	96 hr LC_{50}	130	mg/L						HSDB 1991e; Johnson and Finley 1980
	fathead minnow	96 hr LC_{50}	97	mg/L						HSDB 1991e; Johnson and Finley 1980
	daphnia	48 hr EC50	930	mg/L						Monsanto 1990
	rainbow trout	96 hr LC_{50}	163	mg/L						Mayer and Ellersieck 1986
	rainbow trout	96 hr LC_{50}	130	mg/L						Johnson and Finley 1980
	rainbow trout	96 hr LC_{50}	2.3	mg/L	(41% Roundup)					Johnson and Finley 1980
Polybutene										
	animals	LD_{50}	>15,000	mg/kg						Weiss 1986

(Continued)

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
Mineral Oil										
	Avian									
	chicken embryos	NOEL	0.02	ml on shell	25					
	chicken eggs	death	3/5	ml/egg	>2,000					Christens and Blokpoel 1991
	Mammals									
	animals	LD_{50}	5000	mg/kg						Weiss 1986
	human	lethal	>15,000	mg/kg						HSDB 1991d
	mice	NOEL	1.2	ml on skin						HSDB 1991d
Brodifacoum										
	Avian									
	pheasants	LD_{50}	0.33	mg/kg						HSDB 1991
	barn owls	3 d. lethality	3.7	mg/kg	5					Mendenhall and Pank 1980
	barn owls	1 d. NOEL	1.5	mg/kg	1					Mendenhall and Pank 1980
	mallard	LD_{50}	4.6	mg/kg	17					Godfrey 1986
	chicken	LD_{50}	4.5	mg/kg						RTECS 12/90
	CA quail	LD_{50}	3.3	mg/kg	35					Godfrey 1986
	black-back gull	LD100	0.75	mg/kg	35					Godfrey 1986
	house sparrow	LD_{50}	>6	mg/kg	20					Godfrey 1986
	Harrier hawk	LD_{50}	10	mg/kg	12					Godfrey 1986
	am. kestrels				10	LD40	6 days	4.80	mg/kg-d	Savarie and LaVoie 1979
	am. kestrels	LD_{50}	6 (0.45)	ppm (mg/kg)						USEPA 1991e
	Mammals									
	voles	LD_{50}	0.22	mg/kg						Savarie and LaVoie 1979
	hares	LD_{50}	0.15	mg/kg						HSDB 1991h
	rabbits	LD_{50}	0.3	mg/kg						HSDB 1991h
	rabbits	LD62	0.5	mg/kg						HSDB 1991h
	opossum	LD_{50}	0.17	mg/kg						Godfrey 1986
	mice	LD_{50}	0.4	mg/kg						HSDB, 1991h
	guinea pig	LD_{50}	2.8	mg/kg						HSDB 1991h
	cats	LD_{50}	25	mg/kg						HSDB 1991h; RTECS 12/90
	dogs	LD_{50}	0.25-1	mg/kg						HSDB 1991h
	dogs	LD_{50}	3.56	mg/kg						Mackintosh et al. 1988
	rat	LD_{50}	0.16	mg/kg						HSDB 1991h
	rat	LD_{50}	0.27	mg/kg						Farm Chemical Handbook 1992
	rat				44	LD_{50}	4 days	0.41 (0.02)	ppm (mg/kg-d)	Brooks et al. 1990
	Aquatic									
	bluegill sunfish	LC_{50}	0.089	mg/L						USEPA 1991b
	rainbow trout	LC_{50}	0.045	mg/L						USEPA 1991b
	daphnia	EC50	0.89	mg/L						USEPA 1991b

Table P-11(Continued)

Summary of Toxicological Properties for Pesticides Used by APHIS ADC

Active Ingredient	Species	Acute Toxicity Endpoint	Value	Units	Number of Animals	Chronic Toxicity Endpoint	Duration	Value	Units	Reference
Cholecalciferol										
	Avian									
	poultry	least susceptible								HSDB, 1991i
	mallard	LD_{50}	600	mg/kg						Marshall 1984
	mallard	LC_{50}	1,200 (48)	ppm (mg/kg)						Marshall 1984
	bobwhite quail	LC_{50}	600 (54)	ppm (mg/kg)						Marshall 1984
	Mammals									
	rats	LD_{50}	43.6	mg/kg						Marshall 1984
	mice	LD_{50}	42.5	mg/kg	8					Marshall 1984
	dog	LD_{50}	264	mg/kg						Marshall 1984
	dog	LD_{50}	80	mg/kg						USEPA 1992c
	cats	most susceptible								HSDB 1991i
	rabbits	dermal LD_{50}	1.5	mg/kg						
	human					theraputic dose		10	ug	HSDB 1991i
	human					poison		50,000	units	HSDB 1991i
	Aquatic									
	NA									
Bone Tar oil										
	NA									
Immobilizing/Euthanizing/Agents										
	NA									

ALD = estimated lethal dose, similar to an LD_{50}.
EMLD = estimated median lethal dose.
NA = not available
MTL = median threshold limit.
PEL = Permissable exposure level.
TLV = threshold limit value (inhalation).

Table P-12

Results of Screening Process, Including Critical Element and Scoring Procedures by Specific Formulation

	Critical Elements	*Scoring Results*	
A.I./Product Name	**No Probable Risk**	**QRA not warranted**	**Requires QRA**
Avicides & Other Agents			
Alpha-chloralose		•	
4-Aminopyridine (Avitrol), 0.5%			•
4-Aminopyridine (Avitrol), 25% Concentrate			•
DRC-1339, 98%, feedlots			•
DRC-1339, 98%, structures			•
DRC-1339, 98%, staging areas			•
DRC-1339 (Gull Toxicant)		•	
DRC-1339, 98%, eggs/meat bait			•
DRC-1339 (Starlicide Complete), 0.1%			•
Fenthion (Rid A Bird 11%, BCF #1 9%)			•
Mineral oil	•		
Glyphosate (Rodeo), 53.8%		•	
Compound PA-14 (Tergitol), 99.5%		•	
Polybutene (Eatons 4 the Birds), 80%	•		
Strychnine (Pigeon Bait Strychnine Corn), 0.4%			•
Strychnine (Sparrow-cracks), 0.6%			•
Strychnine Bird Toxicant, 0.35%			•
Rodenticides			
Aluminum Phosphide (Fumitoxin, Phostoxin, Detia-Rotox), 55% or 57%			•
Brodifacoum (Weather Blok), 0.005%	•		
Cholecalciferol (Quintox), 0.075%		•	
Sodium Nitrate (Gas Cartridge for Rodents), 43.36%			•
Strychnine (Strychnine Milo), 0.35%			•
Strychnine (Steam-rolled Oats), 0.5%			•
Strychnine, 1.6% paste			•
Strychnine, 4.9% paste			•
Strychnine, 5.79%, salt block			•
Zinc Phosphide Concentrate for Mouse Control, 63%			•
Zinc Phosphide Concentrate for Muskrat and Nutria Control, 63%			•
Zinc Phosphide Concentrate for Rat Control, 63%		•	
Zinc Phosphide on Steam-rolled Oats, 2%			•
Zinc Phosphide (ZP Rodent Bait AG 2%, D&H Formula Rodent Rid-R 2%, ZP Rodent Bait 2%)			•
Zinc Phosphide on Wheat, 1.82%			•
Predicide & Other Agents			
Bone Tar Oil (Magic Circle Deer Repellent), 93.75%	•		
Sodium Cyanide (M-44 Cyanide Capsules), 88.62%			•
Sodium Fluoroacetate (Compound 1080), Livestock Protection Collar, 1.04%			•
Sodium Nitrate (Gas Cartridge for Coyotes) 65%			•
Immobilizing/Euthanizing Agents (Ketaset, Beuthanasia-D, Rompun)	•		
Summary	5	6	26
Total of 37 products			

Table P-13

End-Use Formulations Designated "No Probable Risk" by Critical Element Screening, Including Basis for Designation

A.I. / Product Name	Are there indications that the material is toxic to mammalian, avian, or aquatic species?	Are there any apparent nontarget exposure pathways?	Are there any nontarget species potentially exposed to the material?	If label restrictions exist, do potentially unmitigated nontarget hazards remain?	No Probable Risk
Mineral oil	No	Yes	Yes	No	•
Polybutene (Eaton's 4 the Birds), 80%	No	Yes	Yes	No	•
Brodifacoum (Weather Blok), 0.005%	Yes	No	No	No	•
Bone Tar Oil (Magic Circle Deer Repellent), 93.75%	No	Yes	Yes	No	•
Immobilizing/Euthanizing Agents	Yes	No	No	No	•

Table P-14

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Alpha-chloralose		
Target Species: Canada geese, ducks, pigeons		
(INAD6602)		
Use Profile Component		
Geographic extent		
1) States of use	1	six States: AL, MI, NM, NV, OH, OK
2) Maximum annual use	1	38 g in AL
3) Maximum labeled application rate	3	medium
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 7	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	3	333 nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	0	none
4) Direct/indirect impacts (T&E sp.)	0	none
5) Human Receptors	0	none
6) Potentially sensitive ecosystems	3	yes (aquatic)
7) Exposure pathways	2	dermal, ingestion
	Subtotal = 8	
Chemical considerations		
8) Mobility (soil, water)	3	moderate mobility
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	unlikely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	none
2) Mammalian	0	LD_{50} > 200 mg/kg
3) Avian	3	42 mg/kg is lowest value
4) Aquatic	3	30 mg bait may have caused death to goldfish
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	0	assumes it is not chronically toxic
7) Avian	2	assumed less toxic than acute value
8) Aquatic	2	assumed less toxic than acute value
Secondary		
9) All species	0	none
	Subtotal = 10	
	Total Score = 30	no probable risk, QRA unnecessary
4-Aminopyridine (Avitrol), 0.5%		
Target Species: sparrows, pigeons, gulls, starlings, blackbirds		
(USEPA No. 11649-1, 11649-4, 11649-6, 11649-7)		
Use Profile Component		
Geographic extent		
1) States of use	1	12 States
2) Maximum annual use	1	189 lb (0.945 lb a.i.), in OK
3) Maximum labeled application rate	1	low a.i.
4) Fraction of year during which application could be made	2	year round
	Subtotal = 5	

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	31 nontargets recorded affected
2) Nontarget receptors (indirect)	1	2 nontargets indirectly affected
3) Threatened and/or endangered species	15	6 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct
5) Human receptors	0	no human injuries
6) Potentially sensitive ecosystems	0	not likely, label requires retreatment after rainfall
7) Exposure pathways	1	ingestion (HSDB)
	Subtotal = 22	
Chemical considerations		
8) Mobility (soil, water)	2	moderately low mobility
9) Persistence (soil, water)	5	high persistence
10) Accumulation of residues between applications	3	potentially exist
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 10	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50} <10 mg/kg
3) Avian	4	LD_{50} <10 mg/kg
4) Aquatic	3	1.4 to 400 mg/L
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	3	2 to 5 mg/kg-d
7) Avian	3	1.8 to 18 mg/kg-d
8) Aquatic	2	assumed based on acute toxicity
Secondary		
9) All species	0	low
	Subtotal = 22	
	Total Score = 59	QRA warranted

Scoring Criteria	Score	Data and Sources
4-Aminopyridine (Avitrol), 25% Concentrate		
Target Species: gulls		
(USEPA No. 11649-10)		
Use Profile Component		
Geographic extent		FY 91
1) States of use	1	2 States, KY, TN
2) Maximum annual use	1	26.8 g in TN
3) Maximum labeled application rate	1	1 oz per site, up to 8 sites
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 5	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	0	no nontargets recorded affected
2) Nontarget receptors (indirect)	0	no nontargets recorded affected
3) Threatened and/or endangered species	0	none
4) Direct/indirect impacts (T&E sp.)	0	none
5) Human receptors	0	no human injuries
6) Potentially sensitive ecosystems	0	none
7) Exposure pathways	1	ingestion
	Subtotal = 1	

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Chemical considerations		
8) Mobility (soil, water)	2	moderately low mobility
9) Persistence (soil, water)	5	high persistence
10) Accumulation of residues between applications	3	potential accumulation
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 10	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50} <10 mg/kg
3) Avian	4	LD_{50} <10 mg/kg
4) Aquatic	3	1.4 to 400 mg/L
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	3	2 to 5 mg/kg-d
7) Avian	3	1.8 to 18 mg/kg-d
8) Aquatic	2	assumed based on acute toxicity
Secondary		
9) All species	0	low
	Subtotal = 22	
	Total Score = 38	QRA warranted
DRC-1339, 98%, feedlots		
Target Species: starlings, blackbirds, pigeons, grackles		
(USEPA No. 56228-10, AZ890007, NM810003, UT890002, WA790002)		
Use Profile Component		
Geographic extent		
1) States of use	2	12 States
2) Maximum annual use	5	1,104 oz (30 kg a.i.) in AZ
3) Maximum labeled application rate	3	45 lbs per acre
4) Fraction of year during which application could be made	1	usually during winter
	Subtotal = 11	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	41 nontargets recorded affected
2) Nontarget receptors (indirect)	0	no nontargets recorded affected
3) Threatened and/or endangered species	15	4 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct and indirect
5) Human receptors	0	no
6) Potentially sensitive ecosystems	3	yes
7) Exposure pathways	2	ingestion, dermal
	Subtotal = 25	
Chemical considerations		
8) Mobility (soil, water)	4	moderately high mobility
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	label requires gloves and protective gear
2) Mammalian	2	50-500 mg/kg
3) Avian	4	1-320 mg/kg
4) Aquatic	1	10-100 mg/L

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Chronic		
5) Human (epidemiologic)	3	methemoglobinemia
6) Mammalian	1	assumed from acute toxicity
7) Avian	4	1 ppm feeding study
8) Aquatic	2	1.6 - 38 mg/L
Secondary		
9) All species	0	low
	Subtotal = 17	
	Total Score = 58	QRA warranted
DRC-1339, 98%, structures		
Target Species: pigeons, starlings, crows		
(USEPA No. IN900003, KY890003, TN890005, GA900008, IL890006, MI910001)		
Geographic extent		
1) States of use	1	6 States
2) Maximum annual use	2	64.2 oz (1.8 kg a.i.) in KY
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 6	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	3 nontargets recorded affected
2) Nontarget receptors (indirect)	1	3 nontargets recorded affected
3) Threatened and/or endangered species	15	2 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	2	indirect
5) Human receptors	0	none
6) Potentially sensitive ecosystems	0	none
7) Exposure pathways	2	ingestion, dermal contact
	Subtotal = 21	
Chemical considerations		
8) Mobility (soil, water)	4	moderately high mobility
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	label requires gloves and protective gear
2) Mammalian	2	50-500 mg/kg
3) Avian	4	1-320 mg/kg
4) Aquatic	1	10-100 mg/L
Chronic		
5) Human (epidemiologic)	3	methemoglobinemia
6) Mammalian	1	assumed from acute toxicity
7) Avian	4	1 ppm feeding study
8) Aquatic	2	1.6 - 38 mg/L
Secondary		
9) All species	0	low
	Subtotal = 17	
	Total Score = 49	QRA warranted

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
DRC-1339, 98%, staging areas		
Target Species: blackbirds, pigeons, grackles		
(USEPA No. LA880012, ND900001, TX890001)		
Use Profile Component		
Geographic extent		
1) States of use	1	3 States: LA, ND, TX
2) Maximum annual use	4	14 lb (6.2 kg a.i.) in LA
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 8	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	21 nontargets recorded affected
2) Nontarget receptors (indirect)	0	no nontargets recorded affected
3) Threatened and/or endangered species	15	5 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct and indirect
5) Human receptors	0	none
6) Potentially sensitive ecosystems	3	yes (aquatic)
7) Exposure pathways	2	ingestion, dermal contact
	Subtotal = 25	
Chemical considerations		
8) Mobility (soil, water)	4	moderately high mobility
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	label requires gloves and protective gear
2) Mammalian	2	50-500 mg/kg
3) Avian	4	1-320 mg/kg
4) Aquatic	1	10-100 mg/L
Chronic		
5) Human (epidemiologic)	3	methemoglobinemia
6) Mammalian	1	assumed from acute toxicity
7) Avian	4	1 ppm feeding study
8) Aquatic	2	1.6 - 38 mg/L
Secondary		
9) All species	0	low
	Subtotal = 17	
	Total Score = 55	QRA warranted
DRC-1339, 98%, eggs/meat bait		
Target Species: ravens, crows, magpies		
(USEPA No. AZ860006, CA-EUP, ID780011, NM880002 NM880002, NV860003, OR780014, UT870001)		
Use Profile Component		
Geographic extent		
1) States of use	1	7 States
2) Maximum annual use	1	less than 1 kg a.i.
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	1	spring and winter usually
	Subtotal = 4	

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	0	no nontargets recorded affected
2) Nontarget receptors (indirect)	0	no nontargets recorded affected
3) Threatened and/or endangered species	15	7 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct
5) Human receptors	0	no
6) Potentially sensitive ecosystems	3	yes
7) Exposure pathways	2	ingestion, dermal contact
	Subtotal = 24	
Chemical considerations		
8) Mobility (soil, water)	4	moderately high mobility
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	label requires gloves and protective gear
2) Mammalian	2	50-500
3) Avian	4	1-320
4) Aquatic	1	10-100 mg/L
Chronic		
5) Human (epidemiologic)	3	methemoglobinemia
6) Mammalian	1	assumed from acute toxicity
7) Avian	4	1 ppm feeding study
8) Aquatic	2	1.6 - 38 mg/L
Secondary		
9) All species	0	low
	Subtotal = 17	
	Total Score = 50	QRA warranted
1339 Gull Toxicant, 98%		
Target Species: Gulls		
(USEPA No. 56228-17)		
Use Profile Component		
Geographic extent		
1) States of use	1	2 States: ME and MA
2) Maximum annual use	1	10 oz in ME
3) Maximum labeled application rate	1	0.7 g per cubes, up to 5 cubes per target
4) Fraction of year during which application could be made	1	spring only
	Subtotal = 4	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	0	no nontargets recorded affected
2) Nontarget receptors (indirect)	0	no nontargets recorded affected
3) Threatened and/or endangered species	0	none
4) Direct/indirect impacts (T&E sp.)	0	none
5) Human receptors	0	none
6) Potentially sensitive ecosystems	0	none
7) Exposure pathways	2	ingestion, dermal contact
	Subtotal = 2	

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Chemical considerations		
8) Mobility (soil, water)	4	moderately high mobility
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	label requires gloves and protective gear
2) Mammalian	2	50-500 mg/kg
3) Avian	4	1-320 mg/kg
4) Aquatic	1	10-100 mg/L
Chronic		
5) Human (epidemiologic)	3	methemoglobinemia
6) Mammalian	1	assumed from acute toxicity
7) Avian	4	1 ppm feeding study
8) Aquatic	2	1.6 - 38 mg/L
Secondary		
9) All species	0	low
	Subtotal = 17	
	Total Score = 28	no probable risk, QRA unnecessary
DRC-1339 (Starlicide Complete), 0.1%		
Target Species: starlings, blackbirds		
(USEPA No. 602-136)		
Use Profile Component		
Geographic extent		
1) States of use	1	2 States: NJ, WA
2) Maximum annual use	1	0.97 lb a.i., in WA
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	1	winter, fall
	Subtotal = 4	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	41 nontargets recorded affected
2) Nontarget receptors (indirect)	0	no nontargets recorded affected
3) Threatened and/or endangered species	15	4 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct and indirect
5) Human receptors	0	no
6) Potentially sensitive ecosystems	3	yes
7) Exposure pathways	2	ingestion, dermal contact
	Subtotal = 25	
Chemical considerations		
8) Mobility (soil, water)	4	moderately high mobility
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	label requires gloves and protective gear
2) Mammalian	2	50-500
3) Avian	4	1-320
4) Aquatic	1	10-100 mg/L

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Chronic		
5) Human (epidemiologic)	3	methemoglobinemia
6) Mammalian	1	assumed from acute toxicity
7) Avian	4	1 ppm
8) Aquatic	2	1.6 - 38
Secondary		
9) All species	0	low
	Subtotal = 17	
	Total Score = 51	QRA warranted
Fenthion (BCF #1 9%, Rid A Bird 11%)		
Target Species: myna, rock dove		
(USEPA No. HI-830005; 7579-2)		
Use Profile Component		
Geographic extent		
1) States of use	1	2 States: HI, KY
2) Maximum annual use	3	8 gallons (0.9 gal a.i.) in KY
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 7	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	0	no nontargets recorded affected
2) Nontarget receptors (indirect)	1	4 nontargets recorded affected
3) Threatened and/or endangered species	15	2 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	2	indirect
5) Human receptors	0	no
6) Potentially sensitive ecosystems	3	yes (aquatic)
7) Exposure pathways	2	dermal, ingestion
	Subtotal = 23	
Chemical considerations		
8) Mobility (soil, water)	2	moderately low mobility assumed
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	3	moderate cumulative action
	Subtotal = 6	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low (dermal)
2) Mammalian	3	LD_{50}: 10-300 mg/kg
3) Avian	4	<10 LD_{50}
4) Aquatic	3	1.6 to 3.2 ppm and .066 ppb to pink shrimp
Chronic		
5) Human (epidemiologic)	3	assumed from acute toxicity
6) Mammalian	3	1 mg/kg/day (60 ppm drinking water NOEL)
7) Avian	3	0.5 mg/kg/d mallard
8) Aquatic	2	assumed from acute toxicity
Secondary		
9) All species	2	moderate
	Subtotal = 26	
	Total Score = 62	QRA

(Continued)

Table P-14(Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Glyphosate (Rodeo), 53.8%		
Target Species: reducing blackbird habitat		
(USEPA No. 524-343)		
Use Profile Component		
Geographic extent		
1) States of use	1	2 States: ND, SD
2) Quantity used (1988 to 1991)	5	566 gal (304.5 gal of a.i.) in ND
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	1	summer only
	Subtotal = 8	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	0	none
2) Nontarget receptors (indirect)	1	habitat loss for other wetland birds
3) Threatened and/or endangered species	0	none
4) Direct/indirect impacts (T&E sp.)	0	none
5) Human receptors	0	none
6) Potentially sensitive ecosystems	3	yes
7) Exposure pathways	2	ingestion, dermal contact
	Subtotal = 6	
Chemical considerations		
8) Mobility (soil, water)	1	low mobility
9) Persistence (soil, water)	3	moderate persistence
10) Accumulation of residues between applications	3	potential
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 7	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	none
2) Mammalian	1	LD_{50} >1,500 mg/kg
3) Avian	0	LD_{50} >2000 mg/kg
4) Aquatic	2	1 to 10 mg/L for formulation (higher for technical material)
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	10 to 500 mg/kg-d
7) Avian	0	non-toxic (assumed from acute toxicity)
8) Aquatic	1	assumed from acute toxicity
Secondary		
9) All species	0	low
	Subtotal = 6	
	Total Score = 27	no probable risk, QRA unnecessary
PA-14 (Tergitol), 99.5%		
Target Species: blackbird, starling		
(USEPA No. 56228-13)		
Use Profile Component		
Geographic extent		
1) States of use	1	3 States: KY, MS, TN
2) Maximum annual use	5	495 gal in TN
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	1	winter only
	Subtotal = 8	

(Continued)

Table P-14(Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	6	2,741 nontargets recorded affected
2) Nontarget receptors (indirect)	0	no nontargets recorded indirectly affected
3) Threatened and/or endangered species	0	none
4) Direct/indirect impacts (T&E sp.)	0	none
5) Human receptors	0	no
6) Potentially sensitive ecosystems	3	yes
7) Exposure pathways	2	ingestion, dermal
	Subtotal = 11	
Chemical considerations		
8) Mobility (soil, water)	4	high solubility
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	>100 (skin irritation and eye damage)
2) Mammalian	0	LD_{50} > 1,000 mg/kg
3) Avian	0	LD_{50} > 100 mg/kg
4) Aquatic	2	1-44 mg/L
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	0	non-toxic
7) Avian	0	non-toxic
8) Aquatic	1	assumed from acute toxicity
Secondary		
9) All species	0	none
	Subtotal = 3	
	Total Score = 27	no probable risk, QRA unnecessary
Strychnine (Pigeon Bait Strychnine Corn), 0.4%		
Target Species: pigeons		
(USEPA No. 56228-08)		
Use Profile Component		
Geographic extent		
1) States of use	1	2 States: TX, LA
2) Maximum annual use	1	40 lbs (0.07 kg a.i.), in TX
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 5	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	10 nontargets reported affected
2) Nontarget receptors (indirect)	1	7 nontargets reported affected
3) Threatened and/or endangered species	15	7 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct and indirect
5) Human receptors	0	no
6) Potentially sensitive ecosystems	3	yes
7) Exposure pathways	3	ingestion, inhalation and dermal contact
	Subtotal = 27	
Chemical considerations		
8) Mobility (soil, water)	2	moderately low mobility
9) Persistence (soil, water)	2	moderately low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 5	

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50} <10 to 28
3) Avian	4	LD_{50} <10
4) Aquatic	3	>0.8 mg/L for bluegill
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL > 1.44 mg/kg-d, so LD_{50} >2
7) Avian	2	NOEL > 3 mg/kg-d, so LD_{50} >3
8) Aquatic	1	assumed from acute toxicity and fate
Secondary		
9) All species	2	moderate
	Subtotal = 21	
	Total Score = 58	QRA warranted
Strychnine (Sparrow-cracks), 0.6%		
Target Species: house sparrow		
(USEPA No. 8612-30)		
Use Profile Component		
Geographic extent		
1) States of use	1	1 State: TX
2) Maximum annual use	1	0.03 lb a.i. in TX
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 5	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	10 nontargets reported affected
2) Nontarget receptors (indirect)	1	7 nontargets reported affected
3) Threatened and/or endangered species	15	7 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct and indirect
5) Human receptors	0	no
6) Potentially sensitive ecosystems	3	yes
7) Exposure pathways	3	ingestion, inhalation and dermal contact
	Subtotal = 27	
Chemical considerations		
8) Mobility (soil, water)	2	moderately low mobility
9) Persistence (soil, water)	2	moderately low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50} <10 to 28
3) Avian	4	LD_{50} <10
4) Aquatic	3	>0.8 mg/L for bluegill
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL > 1.44 mg/kg-d, so LD_{50} >2
7) Avian	2	NOEL > 3 mg/kg-d, so LD_{50} >3
8) Aquatic	1	assumed from acute toxicity and fate
Secondary		
9) All species	2	moderate
	Subtotal = 21	
	Total Score = 58	QRA warranted

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Strychnine Bird Toxicant, 0.35%		
Target Species: grackles, blackbirds		
(USEPA No. 9561-2)		
Use Profile Component		
Geographic extent		
1) States of use	1	1 State: TX
2) Maximum annual use	1	0.001 lbs a.i. in TX
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	1	spring only
	Subtotal = 4	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	10 nontargets reported affected
2) Nontarget receptors (indirect)	1	7 nontargets reported affected
3) Threatened and/or endangered species	15	7 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct and indirect
5) Human receptors	0	no
6) Potentially sensitive ecosystems	3	yes
7) Exposure pathways	3	ingestion, inhalation and dermal contact
	Subtotal = 27	
Chemical considerations		
8) Mobility (soil, water)	2	moderately low mobility
9) Persistence (soil, water)	2	moderately low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50} <10 to 28
3) Avian	4	LD_{50} <10
4) Aquatic	3	>0.8 mg/L for bluegill
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL > 1.44 mg/kg-d, so LD_{50} >2
7) Avian	2	NOEL > 3 mg/kg-d, so LD_{50} >3
8) Aquatic	1	assumed from acute toxicity and fate
Secondary		
9) All species	2	moderate
	Subtotal = 21	
	Total Score = 57	QRA warranted
Aluminum Phosphide (Fumitoxin, Phostoxin, Detia-Rotox), 55% or 57%		
Target Species: pocket gopher, prairie dog, mole, squirrel, muskrat, Norway rat		
(USEPA No. 5857-1, 40285-1, 2548-69)		
Use Profile Component		
Geographic extent		
1) States of use	1	5 States: NE, OK, OR, NM, TX
2) Maximum annual use	5	89,141 tablets (324 lb a.i.) in NM
3) Maximum labeled application rate	1	4 tablets/burrow
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 9	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	0	no nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	15	2 T&E species unmitigated by label; see Table P-9

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
4) Direct/indirect impacts (T&E sp.)	4	direct
5) Human receptors	0	none
6) Potentially sensitive ecosystems	3	yes
7) Exposure pathways	2	inhalation, ingestion
	Subtotal = 24	
Chemical considerations		
8) Mobility (soil, water)	0	insoluble in water
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 1	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50}<10
3) Avian	4	assumes toxic, no information available
4) Aquatic	0	NA
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	assumes phosphide chronically toxic like ZP
7) Avian	2	assumes phosphide chronically toxic like ZP
8) Aquatic	0	NA
Secondary		
9) All species	0	no secondary hazard
	Subtotal = 15	
	Total Score = 49	QRA warranted
Cholecalciferol (Quintox), 0.075%		
Target Species: chipmunks, mice, squirrels		
(USEPA No. 12455-39, EUP)		
Use Profile Component		
Geographic extent		
1) States of use	1	1 State: VT
2) Maximum annual use	1	0.02 lbs a.i.
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	1	spring, summer
	Subtotal = 4	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	0	no nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	0	none
4) Direct/indirect impacts (T&E sp.)	0	none
5) Human receptors	0	none
6) Potentially sensitive ecosystems	0	none
7) Exposure pathways	1	ingestion
	Subtotal = 1	
Chemical considerations		
8) Mobility (soil, water)	0	insoluble in water
9) Persistence (soil, water)	3	moderate persistence
10) Accumulation of residues between applications	3	potential
11) Bioaccumulation in plant and animal tissue	2	moderately low assumed
	Subtotal = 8	

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	none
2) Mammalian	3	LD_{50}: 10 to 50 mg/kg
3) Avian	1	LD_{50}: 501 to 2000 mg/kg
4) Aquatic	1	not soluble in water
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	assumed from acute data
7) Avian	1	LD_{50}: 51 to 200 mg/kg
8) Aquatic	1	not soluble in water
Secondary		
9) All species	0	low
	Subtotal = 9	
	Total Score = 22	no probable risk, QRA unnecessary
Sodium Nitrate (Gas Cartridge for Rodents), 43.36%		
Target Species: ground squirrels, pocket gophers, marmots, woodchucks, prairie dogs		
(USEPA No. 56228-2)		
Use Profile Component		
Geographic extent		
1) States of use	2	15 States
2) Maximum annual use	5	42,800 cartridges (3,478 lb a.i.) in ID
3) Maximum labeled application rate	1	low (1 cartridge per burrow)
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 10	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	4 nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	15	12 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct
5) Human Receptors	0	no
6) Potentially sensitive ecosystems	3	yes
7) Exposure pathways	2	inhalation, ingestion
	Subtotal = 25	
Chemical considerations		
8) Mobility (soil, water)	5	high mobility
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 6	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	< 10 mg/kg
3) Avian	4	< 10 mg/kg
4) Aquatic	4	LC_{50} > 0.05 mg/L
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL > 220 mg/kg-d
7) Avian	2	assumed based on mammal acute/chronic ratio
8) Aquatic	4	LC_{50} >0.01 mg/L
Secondary		
9) All species	0	low
	Subtotal = 23	
	Total Score = 64	QRA warranted

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Strychnine (Strychnine Milo 0.35%, Steam-rolled Oats 0.5%) Above Ground Application		
Target species: ground squirrels, prairie dogs		
(USEPA No. 56228-11, 12)		
Use Profile Component		
Geographic extent		
1) States of use	1	3 States: NE, NM, OR
2) Maximum annual use	5	37.2 lb a.i. for OR
3) Maximum labeled application rate	1	0.035 lb a.i./acre (label)
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 9	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	6	estimated 20,000 nontarget songbirds reported affected
2) Nontarget receptors (indirect)	1	37 nontargets reported affected
3) Threatened and/or endangered species	15	3 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct and indirect
5) Human receptors	0	none
6) Potentially sensitive ecosystems	3	yes (aquatic)
7) Exposure pathways	1	ingestion
	Subtotal = 30	
Chemical considerations		
8) Mobility (soil, water)	2	moderately low mobility
9) Persistence (soil, water)	2	moderately low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50} <10 to 28
3) Avian	4	LD_{50} <10
4) Aquatic	3	>0.8 mg/L for bluegill
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL > 1.44 mg/kg-d, so LD_{50} >2
7) Avian	2	NOEL > 3 mg/kg-d, so LD_{50} >3
8) Aquatic	1	assumed from acute toxicity and fate
Secondary		
9) All species	2	moderate
	Subtotal = 21	
	Total Score = 65	QRA warranted
Strychnine (Strychnine Milo 0.35%, Steam-rolled Oats 0.5%) Below Ground Application		
Target species: pocket gophers		
(USEPA No. 56228-19, 20)		
Use Profile Component		
Geographic extent		
1) States of use	1	4 States: NE, NM, OR, TX
2) Maximum annual use	5	37 lbs for OR
3) Maximum labeled application rate	1	0.035 lb a.i./acre (label)
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 9	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	15 nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	15	5 T&E species unmitigated by label; see Table P-9

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
4) Direct/indirect impacts (T&E sp.)	2	indirect
5) Human receptors	0	none
6) Potentially sensitive ecosystems	0	none
7) Exposure pathways	1	ingestion
	Subtotal = 19	
Chemical considerations		
8) Mobility (soil, water)	2	moderately low mobility
9) Persistence (soil, water)	2	moderately low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50} <10 to 28
3) Avian	4	LD_{50} <10
4) Aquatic	3	>0.8 mg/L for bluegill
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL > 1.44 mg/kg-d, so LD_{50} >2
7) Avian	2	NOEL > 3 mg/kg-d, so LD_{50} >3
8) Aquatic	1	assumed from acute toxicity and fate
Secondary		
9) All species	2	moderate
	Subtotal = 21	
	Total Score = 54	QRA warranted
Strychnine, 1.6% Paste		
Target Species: hares, jackrabbits		
(USEPA No. 56228-27, and ID-810047)		
Use Profile Component		
Geographic extent		
1) States of use	1	1 State: ID
2) Maximum annual use	1	0.1 lb a.i.
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	1	spring, winter
	Subtotal = 4	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	< 10 nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	15	4 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct and indirect
5) Human receptors	0	no
6) Potentially sensitive ecosystems	3	yes (aquatic)
7) Exposure pathways	2	ingestion, and dermal contact
	Subtotal = 25	
Chemical considerations		
8) Mobility (soil, water)	2	moderately low mobility
9) Persistence (soil, water)	2	moderately low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50} <10 to 28

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
3) Avian	4	LD_{50} <10
4) Aquatic	3	>0.8 mg/L for bluegill
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL > 1.44 mg/kg-d, so LD_{50} >2
7) Avian	2	NOEL > 3 mg/kg-d, so LD_{50} >3
8) Aquatic	1	assumed from acute toxicity and fate
Secondary		
9) All species	2	moderate
	Subtotal = 21	
	Total Score = 55	QRA warranted
Strychnine, 4.9% Paste		
Target Species: marmots		
(Reg. #: ID870003, WA900004)		
Use Profile Component		
Geographic extent		
1) States of use	1	2 States: ID, WA
2) Maximum annual use	2	3.44 lbs a.i in ID
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	1	spring or summer
	Subtotal = 5	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	< 10 nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	15	4 T&E species unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct and indirect
5) Human receptors	0	none
6) Potentially sensitive ecosystems	3	yes (aquatic)
7) Exposure pathways	2	ingestion, and dermal contact
	Subtotal = 25	
Chemical considerations		
8) Mobility (soil, water)	2	moderately low mobility
9) Persistence (soil, water)	2	moderately low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50} <10 to 28
3) Avian	4	LD_{50} <10
4) Aquatic	3	>0.8 mg/L for bluegill
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL > 1.44 mg/kg-d, so LD_{50} >2
7) Avian	2	NOEL > 3 mg/kg-d, so LD_{50} >3
8) Aquatic	1	assumed from acute toxicity and fate
Secondary		
9) All species	2	moderate
	Subtotal = 21	
	Total Score = 56	QRA warranted

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Strychnine, 5.79%, Salt Block		
Target Species: Porcupine		
(USEPA No. 56228-04, cancelled)		
Use Profile Component		
Geographic extent		
1) States of use	1	1 State: OR
2) Maximum annual use	1	0.81 lb a.i.
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	1	
	Subtotal = 4	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	15 nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	15	3 T&E sp. unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	2	indirect
5) Human receptors	0	none
6) Potentially sensitive ecosystems	3	yes
7) Exposure pathways	2	ingestion, and dermal contact
	Subtotal = 23	
Chemical considerations		
8) Mobility (soil, water)	2	moderately low mobility
9) Persistence (soil, water)	2	moderately low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 5	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50} <10 to 28
3) Avian	4	LD_{50} <10
4) Aquatic	3	>0.8 mg/L for bluegill
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL > 1.44 mg/kg-d, so LD_{50} >2
7) Avian	2	NOEL > 3 mg/kg-d, so LD_{50} >3
8) Aquatic	1	assumed from acute toxicity and fate
Secondary		
9) All species	2	moderate
	Subtotal = 21	
	Total Score = 53	QRA warranted
Zinc Phosphide Concentrate for Mouse Control, 63%		
Target Species: marmot		
(USEPA No. 56228-6, state EUP)		
Use Profile Component		
Geographic extent		
1) States of use	1	1 State: ID
2) Maximum annual use	2	2.52 lb a.i.
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	1	spring only
	Subtotal = 5	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	1 nontarget reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	15	2 T&E sp. unmitigated by label; see Table P-9

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
4) Direct/indirect impacts (T&E sp.)	4	direct
5) Human receptors	0	none
6) Potentially sensitive ecosystems	0	none
7) Exposure pathways	2	inhalation, ingestion
	Subtotal = 22	
Chemical considerations		
8) Mobility (soil, water)	1	low, relatively insoluble
9) Persistence (soil, water)	2	moderate low persistence
10) Accumulation of residues between applications	0	unlikely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 4	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	none
2) Mammalian	4	LD_{50} < 15 mg/kg
3) Avian	4	LD_{50} >7 mg/kg
4) Aquatic	3	LC_{50}> 0.1 ppm
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL 1 to 5 mg/kg , so LD_{50} is greater
7) Avian	4	LOEL = 0.27 mg/kg
8) Aquatic	2	based on acute toxicity
Secondary		
9) All species	0	low
	Subtotal = 19	
	Total Score = 50	QRA warranted
Zinc Phosphide Concentrate for Muskrat and Nutria Control, 63%		
Target Species: muskrat and nutria		
(USEPA No. 56228-9)		
Use Profile Component		
Geographic extent		
1) States of use	1	3 States: LA, TN, TX
2) Maximum annual use	1	1.7 lb a.i. in TX
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 5	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	0	no nontargets reported affected
2) Nontarget receptors (indirect)	1	2 nontargets reported affected
3) Threatened and/or endangered species	0	none
4) Direct/indirect impacts (T&E sp.)	0	none
5) Human receptors	0	none
6) Potentially sensitive ecosystems	3	yes
7) Exposure pathways	3	ingestion, water, dermal contact
	Subtotal = 7	
Chemical considerations		
8) Mobility (soil, water)	1	low, relatively insoluble
9) Persistence (soil, water)	2	moderate low persistence
10) Accumulation of residues between applications	0	unlikely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 4	

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	none
2) Mammalian	4	LD_{50} < 15 mg/kg
3) Avian	4	LD_{50} >7 mg/kg
4) Aquatic	3	LC_{50}> 0.1 ppm
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL 1 to 5 mg/kg , so LD_{50} is greater
7) Avian	4	LOEL = 0.27 mg/kg
8) Aquatic	2	based on acute toxicity
Secondary		
9) All species	0	low
	Subtotal = 19	
	Total Score = 38	QRA warranted
Zinc Phosphide Concentrate for Rat Control, 63%		
Target Species: Norway rat, black rat		
(USEPA No. 56228-7)		
Use Profile Component		
Geographic extent		
1) States of use	1	5 States: TX, NM, VA, WV, NE
2) Maximum annual use	5	0.47 lb a.i. in NE
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 9	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	0	no nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	0	none
4) Direct/indirect impacts (T&E sp.)	0	none
5) Human receptors	0	none
6) Potentially sensitive ecosystems	0	none
7) Exposure pathways	2	inhalation, ingestion
	Subtotal = 2	
Chemical considerations		
8) Mobility (soil, water)	1	low, relatively insoluble
9) Persistence (soil, water)	2	moderate low persistence
10) Accumulation of residues between applications	0	unlikely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 4	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	none
2) Mammalian	4	LD_{50} < 15 mg/kg
3) Avian	4	LD_{50} >7 mg/kg
4) Aquatic	3	LC_{50}> 0.1 ppm
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL 1 to 5 mg/kg , so LD_{50} is greater
7) Avian	4	LOEL = 0.27 mg/kg
8) Aquatic	2	based on acute toxicity
Secondary		
9) All species	0	low
	Subtotal = 19	
	Total Score = 34	no probable risk, QRA unnecessary

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Zinc Phosphide (on Steam-rolled Oats 2%, ZP Rodent Bait AG 2%, ZP Rodent Bait 2%)		
Target Species: prairie dogs, chipmunks, mice, ground squirrels, kangaroo rat		
(USEPA No. 56228-5,14,18, OK-880001, EUP; 12455-17; 12455-18)		
Use Profile Component		
Geographic extent		
1) States of registration	1	5 States: NE, ND, NM, OK, VT
2) Maximum annual use	5	338 lb a.i. for NE
3) Maximum labeled application rate	3	medium (0.2 lb /acre)
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 11	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	6	555 nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	5	2 T&E species mitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct
5) Human receptors	0	none
6) Potentially sensitive ecosystems	0	none
7) Exposure pathways	2	inhalation, ingestion
	Subtotal = 17	
Chemical considerations		
8) Mobility (soil, water)	1	low, relatively insoluble
9) Persistence (soil, water)	2	moderate low persistence
10) Accumulation of residues between applications	0	unlikely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 4	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	none
2) Mammalian	4	LD_{50} < 15 mg/kg
3) Avian	4	LD_{50} >7 mg/kg
4) Aquatic	3	LC_{50}> 0.1 ppm
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL 1 to 5 mg/kg , so LD_{50} is greater
7) Avian	4	LOEL = 0.27 mg/kg
8) Aquatic	2	based on acute toxicity
Secondary		
9) All species	0	low
	Subtotal = 19	
	Total Score = 51	QRA warranted
Zinc Phosphide (D&H Rodent Rid-R), 2%		
Target Species: ground squirrels, pocket gophers, voles		
(USEPA No. 2393-185-41937)		
Use Profile Component		
Geographic extent		
1) States of use	1	1 State: OR
2) Maximum annual use	5	133.5 lbs a.i. in OR
3) Maximum labeled application rate	3	medium (0.4 lb a.i /acre)
4) Fraction of year during which application could be made	1	spring and summer
	Subtotal = 10	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	6	555 nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	2	1 threatened species unmitigated by label
4) Direct/indirect impacts (T&E sp.)	4	direct

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
5) Human receptors	0	none
6) Potentially sensitive ecosystems	0	none
7) Exposure pathways	2	inhalation, ingestion
	Subtotal = 14	
Chemical considerations		
8) Mobility (soil, water)	1	low, relatively insoluble
9) Persistence (soil, water)	2	moderate low persistence
10) Accumulation of residues between applications	0	unlikely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 4	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	none
2) Mammalian	4	LD_{50} < 15 mg/kg
3) Avian	4	LD_{50} >7 mg/kg
4) Aquatic	3	LC_{50}> 0.1 ppm
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL 1 to 5 mg/kg , so LD_{50} is greater
7) Avian	4	LOEL = 0.27 mg/kg
8) Aquatic	2	based on acute toxicity
Secondary		
9) All species	0	low
	Subtotal = 19	
	Total Score = 47	QRA warranted
Zinc Phosphide on Wheat, 1.82%		
Target Species: voles, house mice		
(USEPA No. 56228-3)		
Use Profile Component		
Geographic extent		
1) States of use	1	3 States: KY, OR, TN
2) Maximum annual use	4	10.92 lb a.i. for KY
3) Maximum labeled application rate	3	medium (0.18 a.i./acre)
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 10	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	6	555 nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	5	1 threatened sp. unmitigated by label
4) Direct/indirect impacts (T&E sp.)	4	direct
5) Human receptors	0	no
6) Potentially sensitive ecosystems	0	no
7) Exposure pathways	2	inhalation, ingestion
	Subtotal = 17	
Chemical considerations		
8) Mobility (soil, water)	1	low, relatively insoluble
9) Persistence (soil, water)	2	moderate low persistence
10) Accumulation of residues between applications	0	unlikely
11) Bioaccumulation in plant and animal tissue	1	low
	Subtotal = 4	
Toxicity Component		
Acute		
1) Human (epidemiologic)	0	none
2) Mammalian	4	LD_{50} < 15 mg/kg
3) Avian	4	LD_{50} >7 mg/kg
4) Aquatic	3	LC_{50}> 0.1 ppm

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL 1 to 5 mg/kg , so LD_{50} is greater
7) Avian	4	LOEL = 0.27 mg/kg
8) Aquatic	2	based on acute toxicity
Secondary		
9) All species	0	low
	Subtotal = 19	
	Total Score = 50	QRA warranted
Sodium Cyanide (M-44 Cyanide Capsules), 88.62% (USEPA No. 56228-15)		
Use Profile Component		
Geographic extent		
1) States of use	2	16 States
2) Maximum annual use	5	84 lb a.i. in TX
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 10	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	6	1559 nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	15	6 T/E sp. unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	4	direct
5) Human receptors	5	all mitigated in general by label, but potentially exist
6) Potentially sensitive ecosystems	3	yes (aquatic)
7) Exposure pathways	3	dermal, ingestion, inhalation
	Subtotal = 36	
Chemical considerations		
8) Mobility (soil, water)	5	high mobility
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 6	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50}: <10
3) Avian	4	LD_{50}: <10
4) Aquatic	4	LD_{50}: <0.1
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	based on acute values and fate
7) Avian	2	based on acute values and fate
8) Aquatic	2	based on acute values and fate
Secondary		
9) All species	0	low
	Subtotal = 21	
	Total Score = 73	QRA warranted

(Continued)

Table P-14 (Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
Sodium Fluoroacetate (Compound 1080), Livestock Protection Collar, 1.04%		
Target species: coyote		
(USEPA No. 56228-22; 46779-1)		
Use Profile Component		
Geographic extent		
1) States of use	1	1 State: TX
2) Maximum annual use	1	1.05 lb a.i. for TX
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	2	year-round
	Subtotal = 5	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	1	7 nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected
3) Threatened and/or endangered species	15	2 T&E sp. unmitigated by label; see Table P-9
4) Direct/indirect impacts (T&E sp.)	2	indirect
5) Human receptors	0	none
6) Potentially sensitive ecosystems	3	yes (aquatic)
7) Exposure pathways	1	ingestion
	Subtotal = 22	
Chemical considerations		
8) Mobility (soil, water)	5	high mobility
9) Persistence (soil, water)	4	moderately high persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	2	moderately low
	Subtotal = 11	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	LD_{50}: <10
3) Avian	4	LD_{50}: <10
4) Aquatic	1	LD_{50} < 50 ppm
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	3	based on acute studies
7) Avian	4	LD_{50} 0.6-20 mg/kg
8) Aquatic	0	based on acute studies
Secondary		
9) All species	4	high
	Subtotal = 23	
	Total Score = 61	QRA warranted
Sodium Nitrate (Gas Cartridge for Coyotes), 65%		
Target species: coyote		
(USEPA No. 56228-21)		
Use Profile Component		
Geographic extent		
1) States of use	2	14 States
2) Maximum annual use	5	233 lb a.i. in CA
3) Maximum labeled application rate	1	low
4) Fraction of year during which application could be made	1	spring or summer
	Subtotal = 9	
Exposure Component		
Biological considerations		
1) Nontarget receptors (direct)	0	no nontargets reported affected
2) Nontarget receptors (indirect)	0	no nontargets reported affected

Continued)

Table P-14(Continued)

Risk Scores for End-Use Formulations Used by APHIS ADC

Scoring Criteria	Score	Data and Sources
3) Threatened and/or endangered species	15	7 T&E sp. unmitigated by label
4) Direct/indirect impacts (T&E sp.)	4	direct
5) Human receptors	0	none
6) Potentially sensitive ecosystems	0	none
7) Exposure pathways	2	inhalation, ingestion
	Subtotal = 21	
Chemical considerations		
8) Mobility (soil, water)	5	high mobility
9) Persistence (soil, water)	1	low persistence
10) Accumulation of residues between applications	0	not likely
11) Bioaccumulation in plant and animal tissue	0	not likely
	Subtotal = 6	
Toxicity Component		
Acute		
1) Human (epidemiologic)	3	low
2) Mammalian	4	< 10 mg/kg
3) Avian	4	< 10 mg/kg
4) Aquatic	4	LC_{50} > 0.05 mg/L
Chronic		
5) Human (epidemiologic)	0	none
6) Mammalian	2	NOEL > 220 mg/kg-d
7) Avian	2	assumed based on mammal acute/chronic ratio
8) Aquatic	4	LC_{50} >0.01 mg/L
Secondary		
9) All species	0	none
	Subtotal = 23	
	Total Score = 59	QRA warranted

(4) Identification of Indicator Wildlife Species

Indicator species were required for the exposure assessment portion of the QRA to delineate potential exposures. Wildlife indicators were believed to be far more representative of potential exposure than human groups, or in most cases, than T&E species, because of their widespread distribution and presence at application sites. Similarly, domestic animal exposures (especially dogs and cats) were considered by reviewing literature, but because of a paucity of data concerning potential adverse effects to these animals, they were not retained as indicator species. Therefore, wildlife indicator species were selected because they are most likely to represent species vulnerable to the potential effects of primary and secondary exposures for each product according to potential exposure pathways and because they represent diverse phyletic or taxonomic groups of wildlife according to exposure types.

The criteria used to identify indicator species included:

- No other species is more likely to be exposed than the indicator species based on its occurrence and abundance in the States and habitats where the pesticide is applied.
- Features of the species' life history (feeding, nesting, roosting, or migratory habits) are amenable to or likely to promote exposure to the pesticide.
- Literature sources are available on the effects of pesticides on the species.
- Toxicological sensitivity has been demonstrated for key pesticides.

Additional criteria, needed to distinguish among candidate indicators and to develop a manageable number of indicator species, included:

- Toxicity of the active ingredient and presence in a majority of the States where the control method is used.
- Target species for each control method.
- Availability and completeness of toxicological or other database information for the indicator species.
- Potential for contaminant bioaccumulation, biomagnification, or other food web effects.
- Representativeness of local ecological (terrestrial, aquatic, or riparian) communities.

Although the evaluation was often similar for each active ingredient, differences inherent in each formulated product were accounted for in the evaluation of indicator species. Based on the above selection criteria, approximately 16 indicator species were selected to assess the risks associated with end-use formulations.

One to two indicator species were generally selected per control method to address primary hazards. These indicators included the eastern meadowlark, northern cardinal, house finch, horned lark, ring-necked pheasant, American crow, black vulture, deer mouse, and red fox for addressing these potential hazards. The American kestrel, golden eagle, and coyote were selected as indicators for potential secondary hazards. In general, one or two species were selected for compounds with suspected secondary toxicity hazards.

Addressing T&E species. Nonlisted indicator species were selected to represent T&E species when the following specific criteria were met: (1) no T&E species would be likely to be more exposed than the indicator species, based on occurrence and abundance of the species in the States and habitats where the pesticide is applied; (2) features of the species' life history are more amenable to or likely to promote exposure to the pesticide; (3) indicator species have been observed to be affected by the pesticide; and (4) toxicological sensitivity has been demonstrated for key pesticides to specific species or species

groups. In general, however, if pesticide application is believed to occur within the range of T&E species (or within a State in which the T&E species occurs), especially if unmitigated by label restrictions, the species was retained for the purposes of risk assessment. Threatened and endangered species considered for these products include but are not limited to Attwater's greater prairie chicken, Aleutian canada goose, Whooping crane, Peregrine falcon, Bald eagle, Northern aplomado falcon, San Joaquin kit fox, jaguarundi, ocelot, Mexican gray wolf, two bear species, two rattlesnake species, mountain beaver, black-footed ferret, a gopher species, desert tortoise, the California condor, and six kangaroo rat species in California (see Table P-9). A discussion of T&E species included as indicators is provided below by formulated product (Stephan et al. 1985).

Aquatic life (freshwater fish and invertebrates) were addressed using the approach by the USEPA Office of Water Regulations and Standards in assigning Ambient Water Quality Criteria, where a battery of test organisms (as available) are arranged sequentially according to toxicological sensitivity. Protection of aquatic life is discussed as part of the quantitative risk assessment for chemicals with significant off-site transport.

Delineation of Exposure Factors. The above indicator species were selected to represent the most exposed and sensitive species present in the States (usually an indicator State) where the chemical control methods are used. Based on the life history characteristics summarized in Table P-17, exposure factors were established for each indicator species for use in the quantitative exposure and risk assessment. The numerical values derived for the quantitative risk assessment include ingestion rate, body weight, percent ingestion of contaminated material in the diet, home range, and fraction of range. Exposure factors to be used in the quantitative risk assessment are summarized in Table P-22. Secondary hazards were addressed with the assumption that the pesticide concentration occurring in the prey (i.e., prey body burden) is equal to the LD_{50} to which the prey species is susceptible. The ingested concentration for the predator is thus calculated as a dose (reported as mg pesticide/kg body wt.). It is assumed that the entire organism is ingested (i.e., none of the gastrointestinal tract is removed), as documented for many investigations of secondary toxicity. This approach was justifiable in light of the evidence that chemical methods evaluated generally do not bioaccumulate (i.e., body burden is not always equivalent to dose).

Table P-17 provides a list of indicator species used in the risk assessment for each end-use formulation. General life histories, food preferences, migratory pattern, habitat requirements, distribution, range, and other characteristics of these species are described in detail in Table P-17 and summarized in the Indicator Species and Exposure Factors section for each end-use formulation.

(5) Exposure Concentrations Using USEPA's "Generic" Approach

When evaluating potential environmental hazards of pesticides in compliance with FIFRA requirements, the USEPA Office of Pesticide Programs routinely employs a standardized generic approach to hazard evaluation, which consists of simplified assumptions for the exposure and toxicity portions of the hazard evaluation (USEPA 1986e; USEPA 1991b). The assumptions are based on numerous studies or observations of general pesticide applications and are designed to expedite hazard evaluations without involving field work, literature review, or exhaustive study. These simplified assumptions cover the following broad areas:

- Use pattern information (e.g., whether a pesticide is incorporated into soils following application, frequency and rate of application, crops protected).
- Exposure assumptions (e.g., generalized environmental fate properties, generalized soil or water concentrations associated with a fixed level of application, generalized nontarget species, types of T&E species, soil properties, bioaccumulation potential).

- Toxicological information (e.g., general acute LD_{50}, LC_{50}, or other values based on standard animal species, extensive use of surrogate rather than site-specific species).

Several of the APHIS ADC chemical methods have been evaluated under the USEPA Request for Section 7 Consultation (USEPA 1991b) using USEPA's generic approach. The focus of the Section 7 Consultation is to determine whether specific T&E species could be susceptible to deleterious impacts by these materials. Compounds evaluated include aluminum phosphide, cholecalciferol, fenthion, sodium cyanide, sodium fluoroacetate, sodium nitrate, and zinc phosphide. In the Conclusions, findings using the USEPA generic approach are compared with findings resulting from the approach used in this assessment.

The approach adopted for this risk assessment does not rely upon extensive simplifying assumptions. Instead, it uses existing databases to develop representative scenarios for toxicological characterization, development of exposure parameters, and other tasks associated with the assessment. This approach, which is described below, is used because:
(1) APHIS ADC registers fewer methods and uses them less widely than many other registrants of pesticides; therefore close supervision of many pesticide applications is possible.
(2) Many products used by APHIS ADC are highly specific (e.g., the Compound 1080 Livestock Protection Collar) and selective for target animals. Both of these conditions vary from the simplified assumptions built into the USEPA approach.

Another consideration involved in the decision not to use USEPA's generic approach was the significance of off-site transport. No generic approach has been developed to assess exposures to compounds for which off-site transport is relatively insignificant (e.g., aluminum phosphide, sodium nitrate, etc.), and it would be difficult and fraught with uncertainty to quantify exposures for these compounds. For those compounds for which off-site transport may be significant, potential environmental hazards can be better analyzed by quantifying exposures using the representative scenario approach.

(6) Quantification of Exposure: Estimated Environmental Concentrations Using Representative Scenario Approach

(a) Overview of Approach

Four active ingredients were designated to have significant off-site transport potential, and for these compounds it was necessary to develop Estimated Environmental Concentrations (EECs) to quantify potential exposures to these compounds. EECs are exposure point concentrations developed by USEPA (1986e). Barnthouse et al. (1986) used EECs to quantify exposures to receptors via specific pathways. The four active ingredients selected for quantitative exposure assessment (4-aminopyridine, DRC-1339, strychnine, and zinc phosphide) are not the only compounds for which off-site transport potential may be significant. However, their key parameters such as use pattern and environmental fate can adequately represent the key parameters for all other compounds for which the off-site transport potential is significant. This underlying assumption is designed to be conservative and is not expected to underestimate potentially hazardous exposures to any other compound.

In view of the specific modes of application and potential exposure pathways, surface water and soil exposure modeling was determined to be the most appropriate approach for estimating EECs (also see earlier discussion on exposure pathways and off-site transport potential). The following sections describe in detail the assumptions, approach, and procedures used to predict the EECs in surface soil and surface water using environmental fate and exposure models. The results of the quantitative exposure assessment are ummarized beginning on page P-131.

The quantitative exposure assessment and calculation of EECs is accomplished using the following steps:

- Selection and establishment of a representative scenario for each compound. This includes the selection of the most appropriate product formulation location, year, resource to be protected, application rate, and the dates of application for simulation.
- Prediction of EECs in surface soil and simulation of off-site runoff and erosion losses of each compound associated with storm events. A field-validated USEPA exposure model is used for predicting surface soil EECs and off-site transport of the organic compounds 4-aminopyridine, DRC-1339, and strychnine. A simplified calculation was used to estimate EECs in surface soil using ground-applied zinc phosphide. Zinc phosphide was not quantitatively evaluated for off-site transport, because it is insoluble in water and therefore unlikely to be subject to off-site transport via runoff. Although zinc phosphide could be transported to aquatic systems as a result of soil erosion, the amount of material used by APHIS ADC is insufficient to produce significant transport by this pathway. Zinc phosphide is most appropriately addressed using the formulation for muskrat and nutria control.
- Prediction of EECs in subsurface (vadose zone) soils and simulation of the potential for leaching through the soil column. Where appropriate, the soil model may also be used for predicting these subsurface EECs, which are instrumental in addressing potential impacts to groundwater. It was not necessary to model 4-aminopyridine and strychnine for vertical transport in soils because: (a) they are known to be relatively immobile in soil systems (Starr and Cunningham 1975, HSDB 1991j, Miller et al. 1983); (b) the use pattern (low application rate and frequency) for each compound suggested that the amount of material applied was insufficient to create significant leaching to groundwater; and (c) they are soluble (approximately 8,796 and 160 mg/L for 4-aminopyridine and strychnine, respectively) and therefore adequately addressed using surface water exposures only. DRC-1339 and Fenthion degrade rapidly (soil half-lives of 2 days and less than 1 day for DRC-1339 and fenthion, respectively) and would not be expected to leach to groundwater, because the degradation process can significantly diminish the concentrations of these compounds before they migrate from the soil surface to groundwater. Potential groundwater exposures for these compounds were therefore also most appropriately addressed using surface water only. Zinc phosphide was not quantitatively evaluated for transport to groundwater because it is insoluble and the amount of material applied per application is not expected to leach to groundwater. Zinc phosphide also decomposes moderately quickly. Two USEPA field-validated models were used to predict EECs in surface water. One model was used to predict EECs for the organic compounds 4-aminopyridine, DRC-1339, and strychnine in two aquatic compartments (water column and benthic sediment) following transport to a surface water body; the other was used to predict EECs for zinc phosphide (as ionized zinc) in a similar aquatic system.
- Finally, the potential for bioaccumulation of residues in aquatic or terrestrial predators as a result of ingesting contaminated prey was addressed. It was not judged necessary to conduct modeling on a systematic basis because the weight of evidence for each of the four active ingredients is strongly suggestive of low potential for bioaccumulation both in aquatic and terrestrial media.

Results from modeling were used to develop exposure point concentrations (EECs) for soils and surface water. All estimated concentrations from models described below were expressed on a time-dependent basis, using chemical-specific environmental fate and transport properties to predict rates of attenuation over time. Predicted time-dependent concentrations are addressed in view of acknowledged toxicological properties to determine the potential for risk resulting from exposure to these substances. For example, a short-term exposure (e.g., 96 hours or less) would be compared to the appropriate acute toxicological benchmark value (usually a 96-hour LD_{50} or LC_{50}). Likewise, longer-term exposure concentrations were compared with subchronic or chronic toxicological

benchmark values to assess the potential for hazard occurring over a significant portion of a life cycle of a given receptor organism. The models used to conduct the analysis are designed to correspond to toxicologically significant time durations.

These concentrations are incorporated into the exposure assessment and compared with appropriate toxicological benchmarks to determine if adverse effects in exposed populations are possible. Although selected parameters are designed to be conservative, there is considerable uncertainty in the overall analysis. A sensitivity analysis was performed for these simulations and incorporated into the uncertainty analysis.

(b) Key Assumptions and Modeling Procedures

To estimate the environmental fate, transport, and exposure potential of the pesticides in various exposure points (surface soil and water), three numerical models were used: Pesticide Root Zone Model (PRZM) and PRZM Input Collator (PIC), Exposure Analysis Modeling System (EXAMS), and Metals Speciation Model (MINTEQA2). These USEPA-sponsored, state-of-the-art models were selected because they have been field-validated and shown to be effective in simulating fate, transport, and exposures of pesticides following their release to the environment.

The key assumption underlying the exposure assessment and modeling approach is that applied pesticides could migrate from the immediate point of application (e.g., feedlots, staging areas, rafts) to adjoining surface soils or surface water. It is further assumed, in the case of soils, that these residues could be transported via surface water runoff or erosion (in the case of zinc phosphide applied on floating rafts) and that residues (i.e., EECs) could occur within the surrounding water body. As discussed below, the models adopted in support of EEC development consider both chemical-specific (e.g., half-life data, partition coefficients, etc.) and environment-specific (e.g., meteorology, soil and water characteristics, etc.) characteristics in developing EECs.

PRZM and PIC. PRZM is a dynamic compartment model that simulates the vertical movement of pesticides and other organic chemicals in unsaturated soil. The model consists of hydrologic and chemical transport components that simulate runoff, erosion, plant uptake, leaching, decay, and volatilization of pesticides. The output of a PRZM assessment is a time series of chemical mass and concentrations leaving the root zone and entering the water table via leaching or leaving the surface soil (upper 2 cm) and entering receiving water bodies via surface runoff and erosion.

PIC is a computer interface that allows the analyst to locate physiographic regions of interest, select soils appropriate to the agricultural use pattern, and build a PRZM input dataset for simulations. PIC/PRZM has been linked to a nationwide physiographic and soil characteristics database that contains the specific information on climate, soils, and crops that control the *in situ* and off-site transport and transformations of pesticides.

PRZM has been validated with both field data and model experiments. It has satisfactorily predicted pesticide degradation (Pennell et al. 1990) and effectively simulated the general processes that affect the transport of pesticides (Carsel et al. 1986). PRZM has also accurately predicted the total concentration of herbicides in soil profiles and predicted that most of the herbicides would degrade or remain at or near the soil surface (Mueller et al. 1992).

EXAMS. EXAMS is an interactive modeling system that allows the user to specify and store the properties of chemicals and ecosystems, run chemical simulation studies in aquatic ecosystems, and predict and analyze probable aquatic fate of organic chemicals over time. The model includes processes of the physical, chemical, and biological phenomena governing the transport and fate of compounds. The user specifies reaction pathways for the production of transformation products of concern, for which further fate and transport is simultaneously simulated. EXAMS output includes tables summarizing input data and predictions of chemical exposure, fate, and persistence. The exposure summary

includes the expected (long-term chronic and 24- and 96-hour acute) environmental concentrations associated with a user-specified pattern of chemical loadings within bed sediments and the water column.

EXAMS has been used by USEPA to evaluate the behavior of relatively field-persistent herbicides and to evaluate dioxin contamination downstream from paper mills (USEPA 1992d). It has also been successfully used to model chemodynamics of synthetic organics in field situations (Games 1982, 1983; Plane et al. 1987; Pollard and Hern 1985; Reinert and Rodgers 1987; Reinert et al. 1987; Sanders and Seiber 1984; Schramm et al. 1988).

MINTEQA2. MINTEQA2 is an equilibrium chemical speciation model for dilute aqueous systems (for metals or other ions only). The model is appropriate for calculating the equilibrium composition of dilute solutions in the laboratory or in natural aquatic systems. It can be used to calculate the mass distribution at equilibrium among dissolved, adsorbed, and solid phases under a variety of conditions. There are 91 chemical components currently available in MINTEQA2 and an additional 25 components that are specific to the adsorption sub-models. The chemical components include major ions such as calcium, iron and sulfur as well as 13 trace metals, including zinc.

Modeling Procedures. To model the behavior and potential transport of pesticides following application, a representative runoff scenario was developed for DRC-1339, strychnine, and 4-aminopyridine. Table P-18 summarizes the exposure scenarios selected for predicting surface soil and water concentrations. The selection of a representative scenario is based on the following assumptions and criteria:

- The formulated product selected for the modeling is widely used and therefore adequately represents this active ingredient, has higher application rate and frequency than other formulations, and potentially impacts nontarget species.
- The hypothetical site location selected for the modeling is located within the State (with highest annual rainfall) in which APHIS ADC used this pesticide to reflect the most conservative possible scenario.
- The maximum application and frequency rates are the maximum specified by the registration label for each formulation.
- Application dates selected were during spring when heavy rains normally occur, to reflect the most conservative possible scenario.
- The simulation year was selected so that the scenario would represent higher than average annual rainfall for the State. In selecting an appropriate year from historic rainfall records contained in the model, the amount of rainfall during the first month following application was also considered.

Based on the representative scenario selected for each compound, PRZM was used to predict surface soil concentrations and off-site runoff and erosion for the three organic compounds. Compound-specific and site-specific parameters were required for PRZM modeling. Compound-specific properties required to activate the model include water solubility, soil degradation rate, soil adsorption coefficient, chemical vapor pressure, projected pesticide application rate, and projected application frequency. Site-specific parameters include geographic location, soil properties (e.g., soil type, texture, bulk density, water content, and organic carbon content), cropping information (e.g., date of planting, emergence, and harvest), hydrologic properties (e.g., hydrologic group, erodibility, Soil Conservation Service runoff curve number) and meteorological information such as daily rainfall, mean monthly temperature, mean daily solar radiation, and other variables.

Table P-19 lists key data, sources of data, and assumptions used in the PRZM model for 4-aminopyridine, DRC-1339, and strychnine. Site-specific data used in the model was estimated using the nationwide physiographic and soil characteristics data base provided within the PIC/PRZM programs that are based on the Major Land Resource Areas

Text continues on page 131.

Table P-15

Potential for Off-Site Transport of Pesticides for which QRA was Conducted Showing Exposure Pathways and Indicators of Potential Concern

Active Ingredient/Product Name	Potential for Off-Site Transport	Potential Exposure Pathways	Indicator Species[a]
Avicides			
4-Aminopyridine/Avitrol 0.5%	significant	primary & secondary ingestion, off-site transport	meadowlark, kestrel, fish
4-Aminopyridine/Avitrol 25%	minimal	primary & secondary ingestion, off-site transport	American crow
DRC-1339 for feedlot	significant	primary ingestion, off-site transport	cardinal, kestrel, fish
DRC-1339 (egg & meat bait)	significant	primary ingestion, off-site transport	golden eagle, coyote
DRC-1339 for structures	significant	primary ingestion, off-site transport	cardinal, kestrel, fish
DRC-1339 for staging areas	significant	primary ingestion, off-site transport	cardinal, kestrel
DRC-1339/Starlicide Complete	significant	primary ingestion, off-site transport	cardinal, kestrel
Fenthion/Rid-A-Bird; BCF#1	minimal	dermal, primary, & secondary ingestion	sparrow
Strychnine Corn Pigeon Bait	significant	primary & secondary ingestion	lark, kestrel, mouse, coyote
Strychnine/Sparrow-cracks	significant	primary ingestion	lark, kestrel, mouse, coyote
Strychnine Bird Toxicant	significant	primary ingestion	lark, kestrel, mouse, coyote
Rodenticides			
Aluminum Phosphide/Fumitoxin; Phostoxin; Detia-Rotox	minimal	inhalation	NA
Sodium Nitrate/Rodent Gas Cartridge	minimal	inhalation	NA
Strychnine/Above Ground (0.35% & 0.5%)	significant	primary & secondary ingestion, off-site	mouse, coyote, fish
Strychnine/Below Ground (0.35% & 0.5%)	significant	primary ingestion, off-site transport	mouse, coyote
Strychnine Rabbit Paste (1.6%)	significant	primary ingestion, off-site transport	mouse, coyote
Strychnine Marmot Paste (4.9%)	significant	primary ingestion, off-site transport	mouse, coyote
Strychnine Salt Block (porcupine)	significant	primary ingestion, off-site transport	mouse, coyote
Zinc Phosphide Concentrate - Mouse (-6)	significant	primary ingestion, off-site transport	mouse
Zinc Phosphide Concentrate - Muskrat (-9)	significant	primary ingestion, off-site transport	fish
Zinc Phosphide Oats (2%)	significant	primary ingestion, off-site transport	pheasant, mouse
ZP Rodent Bait AG; D&H Formula Rid-R; ZP rodent pellets (2%)	significant	primary ingestion, off-site transport	pheasant, mouse
Zinc Phosphide on Wheat (1.82%)	significant	primary ingestion, off-site transport	pheasant, mouse
Predacides & Other Agents			
Sodium Cyanide / M-44 Cyanide Capsules	minimal	inhalation	NA
Sodium Fluoroacetate / Compound 1080	minimal	primary & secondary ingestion	eagle, vulture, fox
Sodium Nitrate / Coyote Gas Cartridge	minimal	inhalation	NA

[a] Aquatic receptors (indicators) addressed for representative scenario formulations only (See Table P-18).

Table P-16

Environmental Fate Properties for Pesticides (Active Ingredient) for which QRA was Conducted[a]

Active Ingredient	CAS #	Density[b] (g/cm3)	Solubility (mg/L)	Kow unitless	Koc unitless	Half-lives: in soil (days)	Half-lives: in water (days)	Vapor Pr. (torr)	BCF[c] unitless
4-Aminopyridine	504-24-5	no data available	8,796[b]	1.8[d]	33[d]	90 - 960[b]	slow	3.7 E-4[d]	0.9
DRC-1339	7745-89-3	no data available	91,600[e]	20.8 - 24.7[e]	124 - 137[f]	< 2 days[e]	4 - 108[e]	1.0 E-4[e]	5.9 - 6.8
Fenthion	55-38-9	1.25	54 - 56[b]	2,028[f]	1,500[g]	1 - 60[h]	1 - 2[g]	3.0 E-5[g]	190
Strychnine	57-24-9	1.36	160[f]	48 - 89[b,d]	68 - 274[b,f]	7 - 28[i]	28 - 112[i]	0[b]	11.2 - 17.8
Aluminum Phosphide	20859-73-8	2.85	not soluble, slightly soluble as gas[j]	NA	NA	3 days or more[k]	reacts with water	2.5 E4 as gas[k]	aluminum: 50 - 231[l]
Sodium Nitrate	7631-99-4	2.26	921,000[b]	NA	NA	no data available	no data available	no data available	does not accumulate in aquatic species
Zinc Phosphide	1314-84-7	4.54	not soluble, slightly soluble as gas[b,k]	NA	NA	< 30 days[j]	reacts with water	0,[b]2.5 E4 as gask	zinc: 50 - 1,130[l]
Sodium Cyanide	143-33-9	1.6	480,000[b]	NA	NA	decomposes within one day[m]	reacts with water	no data available	does not accumulate in aquatic species
Sodium Fluoroacetate	62-74-8	no data available	completely soluble[b]	no data available	no data available	degrades slowly[n]	no data available	0[b]	no data available

[a] Data sources consulted to obtain this information included Hazardous Substances Data Base (1991 and 1992), Environmental Fate and Effects Database (1991), USEPA On-line Database (1989), Howard et al. (1991), Verschueren (1983), Lyman et al. (1990), USEPA AWQC documents, APHIS ADC archives, and the open scientific literature.

[b] Values taken from Hazardous Substances Data Base (1991) for active ingredient.

[c] BCF values used directly where available. Estimated from Kow where not available (Lyman et al. [1990]: log BCF = 0.76 log Kow - 0.23)

[d] Values taken from HSDB (1991) for active ingredient.

[e] Values derived from personal communication with Schafer, DWRC (March 21, 1992).

[f] Estimated value using Lyman et al. (1990): logKoc = 0.544 X logKow + 1.377, NA - Not Applicable.

[g] Values taken from USEPA Pesticide Environmental Fate Online Summary (1989).

[h] Value taken from USEPA (1988b).

[i] Values taken from Howard et al. (1991).

[j] Decomposes completely in 30 days in moist soils (Hilton and Robison, 1972).

[k] Value taken from Material Safety Data Sheet, Research Products Company (1991).

[l] Values taken from (USEPA 1987b; 1988f).

[m] Obtained from USFWS (1975b).

[n] Obtained from Schafer (1990e).

Table P-17

Summary of Life History Characteristics of Indicator Species for Quantitative Risk Assessment

Eastern Meadowlark	
Food preference	- insects during summer; grass and weed seeds and waste grains during fall, winter (DeGraaf et al. 1991)
Migratory pattern	- year-round resident in Oklahoma
Habitat requirements	- inhabits pastures, hayfields, grassy meadows, prairies, open cornfields (Roseberry and Klimstra 1970), DeGraaf et al., 1991)
Home range	- 3 to 32 acres (for w.meadowlark; Brown 1985)
Body mass	- 99 to 112 grams (for w.meadowlark, Long 1981)
Northern Cardinal	
Food preference	- grains, weed seeds, wild fruits, some insects (DeGraaf et al. 1991); studies by McAtee (1908) indicate that diet consists of 9% grain, 24% wild fruit, 36% weed and other seeds, and 2% miscellaneous vegetation,
Migratory pattern	- year-round resident in Louisiana
Habitat requirements	- inhabits forest edges, brushy forest openings, parks, residential areas (DeGraaf et al. 1991)
Home range	- (not well defined)
Body mass	- male average, 43.5 grams; female average, 43.1 grams (Baldwin and Kendeigh 1938)
House Finch	
Food preference	- primarily artificial food sources provided by humans: food from bird feeders, sunflower seeds, millet, milo, tree seeds, and weed seeds (Sprenkle and Blem 1984); also fruits and insects (DeGraaf *et al.*, 1991
Migratory pattern	- year-round resident in Kentucky, Hawaii, and Texas
Habitat requirements	- inhabits rural, suburban, and urban yards; also parks, farms, and open woodlands (DeGraaf et al. 1991)
Home range	- up to 17 acres; average 0.8 acre (Brown 1985)
Body mass	- ranges from 19.3 to 21.8 grams (Sprenkle and Blem 1984)
Horned Lark	
Food preference	- insects during summer; seeds of grasses, weeds, and waste grains during winter (DeGraaf et al. 1991)
Migratory pattern	- year-round resident in Nebraska
Habitat requirements	- farm fields, including stubble fields, plowed ground, and planted fields (Beason and Franks, 1974); also prairies, deserts, tundra (DeGraaf et al. 1*991)*
Home range	- territory size up to 13 acres; density ranges from 4 to 7 pairs per 2.5 acres (Brown 1985)
Body mass	- ranges from 30.3 to 43.4 grams (Montagna 1943)
American Crow	
Food preference	- omnivorous; diet includes grains, seeds, fruits, nuts; also eats insects, small crustaceans, small reptiles, small mammals, eggs and young of birds, and carrion (DeGraaf et al. 1991)
Migratory pattern	- year-round resident in United States
Habitat requirements	- inhabits open and semi-open habitats, favoring open forests, orchards, suburban areas, and parks
Home range	- home range up to 37 miles/day; density ranges from 2 to 10 birds per 250 acres in winter (Brown 1985)
Body mass	- ranges from 340 to 600 grams (Long 1981)
Ring-necked Pheasant	
Food preference	- plant foods, especially waste grains; also weed and grass seeds, acorns, buds, fruit, insects, snakes, mice (DeGraaf et al. 1991); insects and plants in summer; corn or milo in winter (Johnsgard, 1975)
Migratory pattern	- year-round resident wherever found; not migratory
Habitat requirements	- inhabits cultivated farmland with patches of brush or wood lots; fallow fields; meadows (DeGraaf et al. 1991)
Home range	- home range 4 to 8 acres; territory size 2.5 acres per male; minimum habitat area 80 acres per pair (Brown 1985)
Body mass	- average for male, 1,315 grams; average for female, 952 grams

(Continued)

Table P-17(Continued)

Summary of Life History Characteristics of Indicator Species for Quantitative Risk Assessment

Golden Eagle	
Food preference	- diet in Montana study consisted of 87% mammals (primarily rabbits and hares), 12% birds, and 0.4% snakes; game and domestic animals comprised 8.8% of prey; remains of one lamb, possibly taken as carrion, was found at foot of one nest (McGahan 1968)
	- diet also includes other mammals (marmots, prairie dogs, ground squirrels, skunks, mice; also eats grouse, pheasants, owls, hawks, rock doves, magpies, other birds; rattlesnakes, and some carrion (DeGraaf et al. 1991)
Migratory pattern	- year-round resident in western and central Texas (DeGraaf et al. 1991)
Habitat requirements	- inhabits open country, barren areas, open coniferous forests, primarily in hilly and mountain regions
Home range	- home range 4-mile radius; territory size 5.5 to 8 square miles (Brown 1985)
Body mass	- female average, 10.3 pounds (range 8.9 to 12.3 pounds); male average, 8.6 pounds (range 7.8 to 9.6 pounds) (Jackman and Scott 1975)
Black Vulture	
Food preference	- feeds primarily on carrion from city dumps, sewers, road kills; also kills and eats baby herons, domestic ducks, newborn calves, baby lambs, skunks, opossums; occasionally feeds on ripe and rotten fruit and vegetables (DeGraaf *et al.*, 1991)
	- diet in study in Virginia consisted of 65% domestic carrion (27% cattle, 17% swine, 14% poultry, and 6% sheep); 35% wild animal carrion (16% deer, 8% groundhog, 5% opossum, 3% skunk, 3% raccoon (Coleman and Fraser, 1989); (captive turkey vultures consume approximately 140 grams of food each day
Migratory pattern	- year-round resident in Texas
Habitat requirements	- open areas (Coleman and Fraser 1989)
Home range	- annual home range 14,881 hectares, overlaps among vultures (Coleman and Fraser 1989)
Body mass	- approximately 2,000 grams (Coleman and Fraser 1987)
American Kestrel	
Food preference	- diet in California consisted of 17% birds, 26% mammals, 26% reptiles, and 32% insects (Balgooyen 1976)
	- diet in Utah consisted of 79% small mammals, 15% birds, 4% frogs, and 3% insects (Smith et al. 1972)
Migratory pattern	- year-round resident in continental U.S.
Habitat requirements	- inhabits desert, marsh, grassland, and agricultural and suburban areas (DeGraaf et al. 1991)
Home range	- territory size 275 acres during spring and summer; 375 acres during fall and winter (Brown 1985)
Body mass	- average for female, 117.7 grams; average for male, 103.7 grams (Balgooyen 1976)
Deer Mouse	
Food preference	- seeds of conifers and deciduous plants, berries and leaves of forbs and shrubs, earthworms, insects, arachnids, fungi; arthropods more important in mid-summer, seeds in fall (Colorado Fish & Wildlife Data)
study in Colorado and Wyoming	- diet consisted of 75% seeds, 13% green vegetation and fungi; and 12% arthropods (Williams 1959)
study in Colorado	- diet consisted of 39% seeds, 39% arthropods, and 15% green vegetation and fungi (Flake 1973)
study in California	- diet consisted of 35% seeds, 31% arthropods, 22% fruit, 7% leaves, and 5% miscellaneous (Jameson 1952)
Habitat requirements	- occurs in any dry land habitat, including forests, grassland, range land, agricultural areas, and urban areas (Burt and Grossenheider 1980)
Home range	- home range 0.5 to 3 acres or more; summer population of 10 to 15 per acre (Burt and Grossenheider 1980)
Body mass	- 18 to 35 grams (Burt and Grossenheider 1980)
Raccoon	
Food preference	- omnivorous and opportunistic; diet includes primarily fleshy fruit and invertebrates (e.g., crayfish, slugs, insects
Habitat requirements	- inhabits wooded areas near streams, lakes, or marshes in rural and suburban environments
Home range	- home range varies from 13 to 20 acres (Brown 1985)

(Continued)

Table P-17(Continued)

Summary of Life History Characteristics of Indicator Species for Quantitative Risk Assessment

Body mass	- maximum body weight of 12.5 lbs (5.7 kg) (Burt and Grossenheider 1980)
Red Fox	
Food preference	- study in Iowa: diet consisted of 66% mammals (primarily rodents and rabbits), 29% birds, 4% plants (Scott 1955)
study in Missouri:	- diet consisted of 59% mammals (primarily rabbits and mice), 8% birds, 8% poultry, 4% livestock, 4% carrion, 4% invertebrates, and 13% plants (Korschgen 1959)
Habitat requirements	- inhabits mixture of forest and open country (Burt and Grossenheider 1980)
Home range	- home range no more than 5 miles in diameter; most acitivity within 2 square miles (Ables 1975)
Body mass	- 10 to 16 pounds (4.5 to 6.7 kg) (Burt and Grossenheider 1980)
Black-tailed Deer	
Food preference	- prefers browse from shrubs, including huckleberry, salal, blackberry, bitterbrush, and snowbrush.
Habitat requirements	- inhabits forest-edge areas and brush thickets.
Home range	- home range area ranges from 90 to 600 acres (0.4 to 2.4 km) or more (Brown 1985).
Body mass	- maximum body weight of 150 lbs (68 kg) (Walker *et al.*, 1975).
Coyote	
Food preference	- diet consisted primarily of small rodents and rabbits, but will eat almost anything animal or vegetable (Burt Grossenheider 1980)
study in Iowa	- diet consisted of 51% rabbits, 26% livestock (cattle, pig, sheep), 20% other mammals; 3% birds, 0.5% plants and miscellaneous (Andrews and Boggess 1978)
study in Oklahoma	- diet consisted of 37% small mammals (rodents and rabbits), 20% deer, 4% cattle, 19% fruits and seeds, 11% birds, 11% insects, 5% armadillo, 2% reptiles (Litvaitis and Shaw 1980)
Habitat requirements	- inhabits prairies, open woodlands, brushy areas, marshes, and suburban areas.
study in Nebraska	- habitat use consisted of 74% fields, 17% pasture, 6% farmsteads and roads, and 3% forest and brushy areas (Andelt 1981)
Home range	- home range 4 to 16 square miles (Brown 1985)
Body mass	- 20 to 50 pounds (9 to 22 kg) (Burt and Grossenheider 1980)

Table P-18

Selection of Parameters Used for Representative Scenario Modeling with PRZM/EXAMS/MINTEQA2

Active Ingredient	Product Formulation	Selected State	Resource Protected	Application Rate	Application Frequency	Simulation Year[a]	Application Dates
Representative Scenario for Modeling EECs Using PRZM and EXAMS							
4-Aminopyridine	Avitrol (0.5% a.i.)	OK	property	3 lbs. per acre (0.03% a.i.)	once/ yr	1953	4/20
DRC-1339	DRC-1339 (staging areas) (98% a.i.)	LA	sprouting rice	100 lbs. per acre (0.5% a.i.)	twice/yr	1953	4/20, 5/1
Strychnine	0.5% Strychnine S.R.O. (above ground)	NE	range land	10 lbs. per acre (0.5% a.i.)	once/ yr	1949	4/4
Representative Scenario for Estimating EECs in Surface Soil							
Zinc Phosphide	ZP Rodent Bait AG (2%)	ND	grain crops	20 lbs. per acre (2%)	once/yr	NA	NA
Representative Scenario for Modeling EECs of Zinc Using MINTEQA2							
Zinc Phosphide	ZP for Muskrat Nutria Control (63% a.i.)	LA	dike	10 lbs. per raft (30.24 grams of a.i.)	twice/yr	NA	NA

NA - Not applicable

[a] Simulation year selected to represent higher than average annual rainfall.

Table P-19

Key Parameters and Data Used as Input in PRZM Model

Parameter	Unit	Active Ingredient		
		4-Aminopyridine	DRC-1339	Strychnine
Geographic Region:				
State		OK	LA	NE
MLRA[a]		P-133B	P-133B	M-106
annual average rainfall[b]	cm	103-135	103-135	75-92.5
Chemical Properties:[e]				
water solubility	mg/L	8796	91600	160
half-life in soil	days	450	2	28
Koc	part. coeff.	33	137	274
vapor pressure	torr	0.00037	0.00106	0
Soil Properties:[c]				
name		Desha	Desha	Wymore
texture		Silt Loam	Silt Loam	Silty Clay Loam
bulk density	g/cm^3	1.6	1.6	1.2
field capacity	cm^3/cm^3	0.375	0.375	0.428
wilting point	cm^3/cm^3	0.255	0.255	0.218
organic carbon content		2.3	2.3	2.3
Kd	cm^3/g	0.77	3.18	6.36
Crop:[c]				
name		No crops	Rice	Grass/Pasture/ Hay
planting date		NA	16-Apr	05-Apr
emergence date		NA	26-Apr	15-Apr
maturity date		NA	08-Jun	17-May
harvest date		NA	21-Aug	01-Jun
Mode of Application:				
rate (a.i.)[f]	kg/ha	0.001	0.56	0.056
depth of incorporation	cm	0	0	0
frequency per year[f]		1	2	1
year		1953	1953	1949
date		20-Apr	20-Apr, 01-May	04-Apr
rainfall during selected year[c]	cm	118	118	103
Hydrologic Properties:[c]				
HGRP[d]		D	D	D
pan factor		0.76	0.76	0.76

(Continued)

Table P-19 (Continued)

Key Parameters and Data Used as Input in PRZM Model

		Active Ingredient		
Parameter	**Unit**	**4-Aminopyridine**	**DRC-1339**	**Strychnine**
snow factor		0.15	0.15	0.15
max. depth of evapotranspiration		19.5	19.5	15
erodibility parameter		0.19	0.19	0.26
max. interception storage of the crop	cm	0	0.1	0.25
max. active root depth of the crop	cm	0	12	17
max. areal coverage of the crop at full canopy	%	0	80	100
soil surface condition after crop harvest		NA	residue	residue
universal soil loss equation (LS) topographic factor		1	1	1
runoff curve # for fallow,crop,residue		94/94/94	94/91/93	94/91/93

[a] MLRA- Major Land Resource Areas as defined by USDA (1981).

[b] Annual average rainfall in the selected MLRA, from "Land Resource Regions and MLRAs of the United States" (USDA 1981).

[c] Values taken from or estimated using PRZM Input Collator (PIC) database.

[d] HGRP - Hydrologic Group as defined by SCS/USDA (USEPA 1992d).

[e] References for these properties included in Table P-16.

[f] Based on the registration label and personal interview with APHIS ADC state directors in Kentucky and Louisiana.

(NA- Not Applicable.)

(MLRA) designated by USDA (1981). The simulation site corresponds to the MLRA that overlays the selected State for the representative scenario. The soil characteristics used in the representative scenario were based on the recommended runoff soil for the simulation area in the PIC/PRZM database. The meteorological information used in the simulations was obtained from the USEPA Environmental Research Laboratory, Athens, GA. These data were originally obtained from the National Weather Service and have been formatted for use with the PRZM model.

The EXAMS modeling was conducted to predict time-dependent EECs for a hypothetical pond, using the pesticide runoff and erosion data generated by the PRZM model. EXAMS estimates concentrations for both the water column and benthic sediments, presented as dissolved and particulate-bound in each compartment. The representative scenario assumed that pesticide residues are transported via surface water runoff and erosion from a drainage area of 10 acres to a hypothetical pond. It is assumed that the pond used for modeling with EXAMS consists of two aquatic compartments, with a specified size and depth (USDA 1982, USEPA 1991f). Key parameters for the pond used for modeling are included in Table P-20.

EXAMS was run in the pulse-loading mode to simulate typical pesticide inputs. The magnitude of each loading was calculated by incorporating runoff and erosion data generated from the PRZM model and the assumed drainage area. It is further assumed that these residues enter the water column. Assumptions concerning the pesticide parameters used in the EXAMS modeling are provided in Table P-21; parameters for which no data were found are not included. EXAMS default values were used for parameters for which no data were obtained.

The discussion of specific products presents the assumptions and parameters considered in the representative modeling scenario using PIC/PRZM and EXAMS. All assumptions were designed to be highly conservative (following the RME paradigm) and may overestimate actual exposures.

(c) Results of Exposure Assessment

Modeling results include EECs for base case conditions under which the modeling was conducted. Results of the exposure modeling in surface soils and water by compound are graphically presented on Figures P-4 to P-12, and numerical values are presented in Table P-22 in support of the text provided in the discussion of specific products.

Table P-20

Key Parameters of the Hypothetical Pond Used in EXAMS Model.

Parameter	EXAMS term	Unit	Water Column	Benthic
Physical Geometry:[a]				
area	AREA	m^2	4,047	4,047
width	WIDTH	m	64	64
length	LENGTH	m	64	64
depth	DEPTH	m	1.82	0.05
Other Properties:				
bacterio-plankton population density[b]	BACPL	cfu/mL	100,000	NA
benthic bacteria[b]	BNBAC	cfu/100g	NA	20,000,000
plankton biomass[b]	PLMAS	dry weight/L	0.4	NA
benthic biomass[b]	BNMAS	dry g/m^2	NA	0.01
stream flow[c]	STFLO	m^2/hr	0	0
non-point-source flow[c]	NPSFL	m^2/hr	0	0
stream-borne sediment[c]	STSED	kg/hr	0	0
non-point-source sediment[c]	NPSED	kg/hr	0	0
seUSEPAge flows[c]	SEEPS	m^2/hr	0	0
evaporation[c]	EVAP	mm/month	0	0
suspended sediment[b]	SUSED	mg/L	30	NR
bulk density[b]	BULKD	g/cm^2	NR	1.85
percent of water[b]	PCTWA		NR	137
organic carbon content[b]	FROC		0.05	0.1
dissolved oxygen[d]	DISO2	mg/L	6.5	NR
wind speed @ 10 cm above water	WIND	m/s	1	NA
chlorophyll-like pigments[b]	CHL	mg/L	0.002	0.002
pH[e]	PH		7	7
temperature[f]	TCEL	degrees C	15	15
dispersion coefficient[b]	DSP	m^2/hr	0.0000285	0.0000285

[a] Based on USDA (1982).
[b] Based on typical values used in EXAMS model and pers. comm. with L. Burns, of USEPA, ERL, Athens, GA (April, 1992).
[c] Based on the assumption that no water or sediment is flowing into or out of the pond system.
[d] Assumed based on the average value of water quality criteria for cold and warm water (USEPA 1986c).
[e] The system is assumed to have a pH of 7.
[f] Assumed based on the average temperature in the area.
(NA - Not applicable.)
(NR - Not required by the EXAMS model.)

Table P-21

Key Parameters and Data Used as Input in EXAMS Model[a]

Parameter	EXAMS term	unit	Active Ingredient: 4-Aminopyridine	DRC-1339	Strychnine
Chemical Properties:[b]					
molecular weight	MWT	g/mole	94.13	178	334.4
vapor pressure	VAPR	torr	0.00037	1.06E-04	0
octanol/water coeff. (Kow)	KOW	unitless	18	24.7	89
adsorption coeff. (Koc)	KOC	unitless	33	137	274
water solubility	SOL	mg/L	8796	91600	160
Biolysis Process:					
1st order rate		1/hr	1.05E-03[c]	2.66E-04[d]	2.48E-02[e]
2nd order rate (bacterioplankton)	KBACW	1/(cfu/mL)/hr	1.05E-08	2.70E-09	2.48E-07
2nd order rate (benthic-bacterial)	KBACS	1/(cfu/mL)/hr	1.05E-08	2.70E-09	2.48E-07
Hydrolysis Process:					
neutral hydrolysis rate	KNH	1/hr	0[f]	0[d]	0[i]
acid/base diss. const. (pK)	PK		9.17[g]	0[f]	8.26g
Oxidation Process:					
photo-oxidation rate (1st order)		1/hr	4.3E-03[h]	0[f]	0[f]
photo-oxidation rate (2nd order)	K1O2	per mole [O2]/hr	4.3E-09[j]	NA	NA
Photolysis Process:					
1st order rate	KDP	1/hr	0[f]	1.70E-02	0[f]
reference latitude	RELAT	degree	34	31	41

[a] Processes not listed in this table are not considered in the EXAMS simulations.

[b] References for these properties included in Table P-16.

[c] Assumed from soil degradation half-life.

[d] Value derived from Schafer (1987).

[e] Value taken from Howard et al. (1991).

[f] No data found; the value was assumed to be zero.

[g] Values taken from HSDB (1991a, j) for 4-AP and strychnine.

[h] Based on estimated rate constants for aromatic amine chemical class (Howard et al. 1991).

[i] Value derived from Mishalanie et al. (1989).

[j] Based on the singlet oxygen concentration of 1.0E-12 mole in the surface water of the pond (L. Burns, USEPA/ERL/Athens, pers. comm., 4/27/1992).

(NA - Not applicable)

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c. Toxicological Assessment

This section summarizes the toxicological properties of pesticides for which QRA was conducted, and the approach used to define toxicological benchmark values required for the purpose of risk assessment. The approach involves evaluation of available toxicological studies, and estimation of both **acute** and **chronic** benchmark values for key wildlife receptors (indicator species).

No toxicological testing was conducted for the risk assessment.

Pertinent toxicological data for each of the QRA pesticides, which is summarized in the following sections, was obtained from Federal agency documents, USEPA registration records, and scientific literature. The key emphasis is placed upon developing realistic but conservative toxicological benchmark values. In the absence of formal regulatory or other guidance for developing such values, general USEPA guidance for developing conservative benchmark values was used, as warranted. This guidance must be used judiciously, because of its reliance on human and aquatic toxicology. Human and aquatic toxicology have been more extensively studied than terrestrial wildlife toxicology. The overall approach to deriving toxicological benchmarks is believed conservative because regulatory oversight generally does not require that wildlife be protected as rigorously as is human health. This approach is discussed in greater detail in the following section.

Chronic toxicity tests were based on the most sensitive endpoint (as measured by dose-response information) where available. Subchronic or acute tests were used only when no chronic information was available or when acute toxicity represented the most appropriate endpoint. Test organisms selected represented the most taxonomically or physiologically similar species to indicator organisms of concern, although the use of surrogate species was necessary because information for the specific indicator species was not always available. It is also conservatively assumed that the most sensitive measured endpoint is of significance to the population being protected.

Uncertainty factors (UFs) were applied as appropriate to published toxicological values (e.g., LD_{50}s, LOAELs, NOAELs) to ensure a conservative approach that would tend toward overestimation of potential toxicity for the selected indicator species. Acute dose-response data was generally more available than chronic or subchronic information. In such cases, UFs were applied to acute LD_{50} or LC_{50} values for terrestrial and aquatic organisms, respectively, to represent acute NOAEL values, with an additional factor representing extrapolation of acute-to-chronic NOAEL. An additional UF was also applied to account for interspecies variability and provide a conservative estimate of toxicity for endangered species. For example, a well-documented LD_{50} value of 1.0 mg/kg could yield a benchmark value of 1.0/45 UF (1 for quality of the data, 3 for interspecies variability, 5 for acute to chronic, and 3 for acute to NOEL) = 0.02 mg/kg-day. In the case of key well-studied compounds, completeness of the database contributed to reduced uncertainty in these extrapolations.

This approach is consistent with general guidance from USEPA (1991c; 1989e) and other literature sources which address derivation of benchmark values where only acute or subchronic information is available (Lewis et al. 1990). Benchmark values calculated for each QRA active ingredient were adopted in support of the risk assessment. Both the benchmark values and the rationale for their derivation are presented in Table P-23.

(1) Uncertainty Factors Used to Derive Toxicological Benchmarks

A key element of the risk assessment involves development of toxicological benchmark values for nontarget wildlife, because these values quantitatively estimate the toxicity of QRA compounds to representative sensitive organisms. A dose or intake below the indicated benchmark value is assumed not to produce an adverse effect in the indicator species at the specified time duration. This is consistent with the current understanding of most toxicological processes (modes of action), because protective mechanisms within an

Table P-22

Key Exposure Parameters Used for Quantitative Risk Assessment by End-Use Formulation[a]

Active Ingredient	Indicator Species (wildlife)	Exposure Pathway	Total Ingestion Rate [b] (g/day)	Body Weight (g/animal)
4-Aminopyridine (Avritol, 0.5%)	eastern meadowlark *(Sturnella magna)*	ingestion of bait	10.5	105
	American kestrel *(Falco sparverius)*	ingestion of prey	5.55	111
	freshwater fish	water	NA	NA
(Avitrol 25% Concentrate)	American crow	ingestion of bait	32	400
DRC-1339 (98%)	(representative scenario is staging area)			
(staging area)	northern cardinal *(Cardinalis cardinalis)*	ingestion of bait	6.47	43
(staging area)	American kestrel *(Falco sparverius)*	ingestion of prey	5.55	111
(egg and meat baits)	golden eagle *(Aquila chrysaetos)*	ingestion of bait	234	4,672
(egg and meat baits)	coyote *(Canis latrans)*	ingestion of bait	650	10,000
(structures)	House finch *(Carpodacus mexicanis)*	ingestion of bait	4.36	22
(feedlots and Starlicide)	eastern meadowlark *(Sturnella magna)*	ingestion of bait	10.5	105
(staging area)	freshwater fish	water	NA	NA
Fenthion	house finch *(Carpocadus mexicanis)*	dermal absorption	4.36	22
	American kestrel *(Falco sparverius)*	ingestion of prey	5.55	111
Strychnine	(representative scenario is SRO 0.5% above ground)			
Pigeon Bait/Bird Toxicant/ Sparrow Cracks	eastern meadowlark *(Sturnella magna)*	ingestion of bait	10.5	105
Pigeon Bait/Bird Toxicant/ Sparrow Cracks	American kestrel *(Falco sparverius)*	ingestion of prey	5.55	111
SRO 0.5% (above ground)	horned lark *(Eremophilla alpestris)*	ingestion of bait	5.55	37
SRO 0.5% (all uses)	American kestrel *(Falco sparverius)*	ingestion of prey	5.55	111
SRO 0.5% (all uses)	deer mouse *(Peromyscus manicutalis)*	ingestion of bait	4.59	27
SRO 0.5% (all uses)	coyote *(Canis latrans)*	ingestion of prey	650	10,000
0.35% milo	horned lark *(Eremophilla alpestris)*	ingestion of bait	5.55	37
0.35% milo	deer mouse *(Peromyscus manicutalis)*	ingestion of bait	4.59	27

(Continued)

Diet Fraction							Calculated Pesticide Concentration[e]				
Grain	Birds	Mammals	Carrion	Home Range (acres)	Estimated % of Range[c]	Repellency Factor[d]	Soil[f] maximum/ minimum (mg/kg)	Water maximum/ minimum (mg/L)	Grain (mg/kg)	% Degradation	Tissue (mg/kg)
50%	NA	NA	NA	3	100%	1%[d]	0.0031/ 0.0001	0.00029/ 0.00018	1,000	98%	4.90
NA	16%	NA	NA	275	7%	NA	0.0031/ 0.0001	0.00029/ 0.00018	1,000	98%	4.90
NA	NA	NA	NA	NA	100%	NA	NA	0.0003	NA	NA	NA
50%	NA	NA	NA	20	50%	NA	0.0031	NA	167 [g]	98%	NA
50%	NA	NA	NA	3	100%	NA	1.3/ 0.09	0.029/ 0.023	5,000	4%	NA
NA	16%	NA	NA	275	7%	NA	1.3/ 0.09	0.029/ 0.023	NA	NA	17.7
NA	NA	NA	5%	3,520	3%	NA	1.3/ 0.09	0.029/ 0.023	NA	NA	5,000
NA	NA	NA	10%	10,800	1%	NA	1.3/ 0.09	0.029/ 0.023	NA	NA	5,000
50%	NA	NA	NA	0.8	100%	NA	1.3/ 0.09	0.029/ 0.023	3,700	4%	NA
50%	NA	NA	NA	3	100%	NA	1.3/ 0.09	0.029/ 0.023	1,000	4%	NA
NA	NA	NA	NA	NA	100%	NA	NA	0.029	NA	NA	NA
NA	NA	NA	NA	0.80	100%	NA	NA	NA	1.E+5 [h]	NA	NA
NA	16%	NA	NA	275	7%	NA	NA	NA	NA	NA	9.5
50%	NA	NA	NA	3	100%	NA	0.23/ 0.06	0.0046/ 4.3E-05	6,000	80%	NA
NA	16%	50%	NA	275	7%	NA	0.23/ 0.06	0.0046/ 4.3E-05	NA	NA	21
50%	NA	NA	NA	13	100%	NA	0.23/ 0.06	0.0046/ 4.3E-05	5,000	80%	NA
NA	16%	50%	NA	275	7%	NA	0.23/ 0.06	0.0046/ 4.3E-05	NA	NA	14
50%	NA	NA	NA	0.5	100%	NA	0.23/ 0.06	0.0046/ 4.3E-05	5,000	80%	NA
NA	NA	54%	NA	10,800	1%	NA	0.23/ 0.06	0.0046/ 4.3E-05	5,000	80%	21
50%	NA	NA	NA	13	100%	NA	0.23/ 0.06	0.0046/ 4.3E-05	3,500	80%	NA
50%	NA	NA	NA	0.5	100%	NA	0.23/ 0.06	0.0046/ 4.3E-05	3,500	80%	NA

(Continued)

Table P-22 (Continued)

Key Exposure Parameters Used for Quantitative Risk Assessment by End-Use Formulation[a]

Active Ingredient	Indicator Species (wildlife)	Exposure Pathway	Total Ingestion Rate [b] (g/day)	Body Weight (g/animal)
1.6% paste	deer mouse *(Peromyscus manicutalis)*	ingestion of bait	4.59	27
4.9% paste	deer mouse *(Peromyscus manicutalis)*	ingestion of bait	4.59	27
Salt block	(i)			
(SRO above ground)	freshwater fish	water	NA	NA
Zinc Phosphide	(representative scenario is 2% AG and muskrat for aquatic receptors)			
2% AG (all 1.8-2% baits)	ring-necked pheasant *(Phasianus colchicus)*	ingestion of bait	56.65	1,133
2% AG (all 1.8-2% baits)	deer mouse *(Peromyscus maniculatis)*	ingestion of bait	4.59	27
For mouse control	deer mouse *(Peromyscus maniculatis)*	ingestion of bait	4.59	27
For muskrat and nutria control	freshwater fish	water	NA	NA
	freshwater fish	zinc in water	NA	NA
Sodium Fluoroacetate (Compound 1080)	golden eagle *(Aquila chrysaetos)*	ingestion of bait	234	4,672
	black vulture *(Coragyps atratus)*	ingestion of bait	140	2,000
	red fox *(Vulpea fulva)*	ingestion of bait	177	5,900
	red fox *(Vulpea fulva)*	ingestion of prey	177	5,900

[a] Information taken from Tables P-17, P-19, and Figures P-4 to P-12.

[b] Information derived from Kenaga (1973), using fraction of body weight consumed.

[c] Assumed application areas of 20 to 100 acres divided by home range listed in Table P-17.

[d] Besser et al. (1984), estimate that distress cries clears targets from treated fields with less than 1% of the population directly affected.

[e] Calculated environmental concentrations based on soil and water modeling (Figures P-4 to P-12), bait concentration and degradation, and LD_{50} prey concentration.

[f] Soil ingestion assumed to be 5% of daily ingestion rate for all terrestrial animals.

[g] Pesticide intake equal to one cube ingested covered with 167 mg of a.i.

[h] Assumes that the exposure point concentration for feet (via dermal absorption) is the same as the formulated product (11%). Assumes the area of dermal exposure on birds feet is 5 cm^2.

[i] Indicator species of the representation scenario; horned lark, American kestrel, deer mouse, and coyote.

NA = Not applicable.

Diet Fraction							Calculated Pesticide Concentration[e]				
Grain	Birds	Mammals	Carrion	Home Range (acres)	Estimated % of Range[c]	Repellency Factor[d]	Soil[f] maximum/ minimum (mg/kg)	Water maximum/ minimum (mg/L)	Grain (mg/kg)	% Degradation	Tissue (mg/kg)
50%	NA	NA	NA	0.5	100%	NA	0.23/ 0.06	0.0046/ 4.3E-05	8,300	80%	NA
50%	NA	NA	NA	0.5	100%	NA	0.23/ 0.06	0.0046/ 4.3E-05	2,700	80%	NA
NA	NA	NA	NA	NA	100%	NA	NA	0.0046	NA	NA	NA
50%	NA	NA	NA	4	100%	NA	1.375	0.0041 0.0004	2,000	57%	NA
50%	NA	NA	NA	0.5	100%	NA	1.375	0.0041 0.0004	2,000	57%	NA
50%	NA	NA	NA	0.5	100%	NA	1.375	0.0041 0.0004	6,600	57%	NA
NA	NA	NA	NA	NA	100%	NA	NA	0.0041	NA	100%	NA
NA	NA	NA	NA	NA	100%	NA	NA	0.0004	NA	100%	NA
NA	NA	NA	5%	3,520	3%	NA	NA	NA	NA	NA	NA
NA	NA	NA	100%	36,771	0.27%	NA	NA	NA	NA	NA	NA
NA	NA	NA	10%	1,280	8%	NA	NA	NA	NA	NA	NA
NA	NA	NA	10%	1,280	8%	NA	NA	NA	NA	NA	5.00

Figure P-4 **Short-term (21 days) Concentrations in Surface Soil (upper 2cm) and Off-site Transport of 4-aminopyridine by Storm Events Following Bait Application**

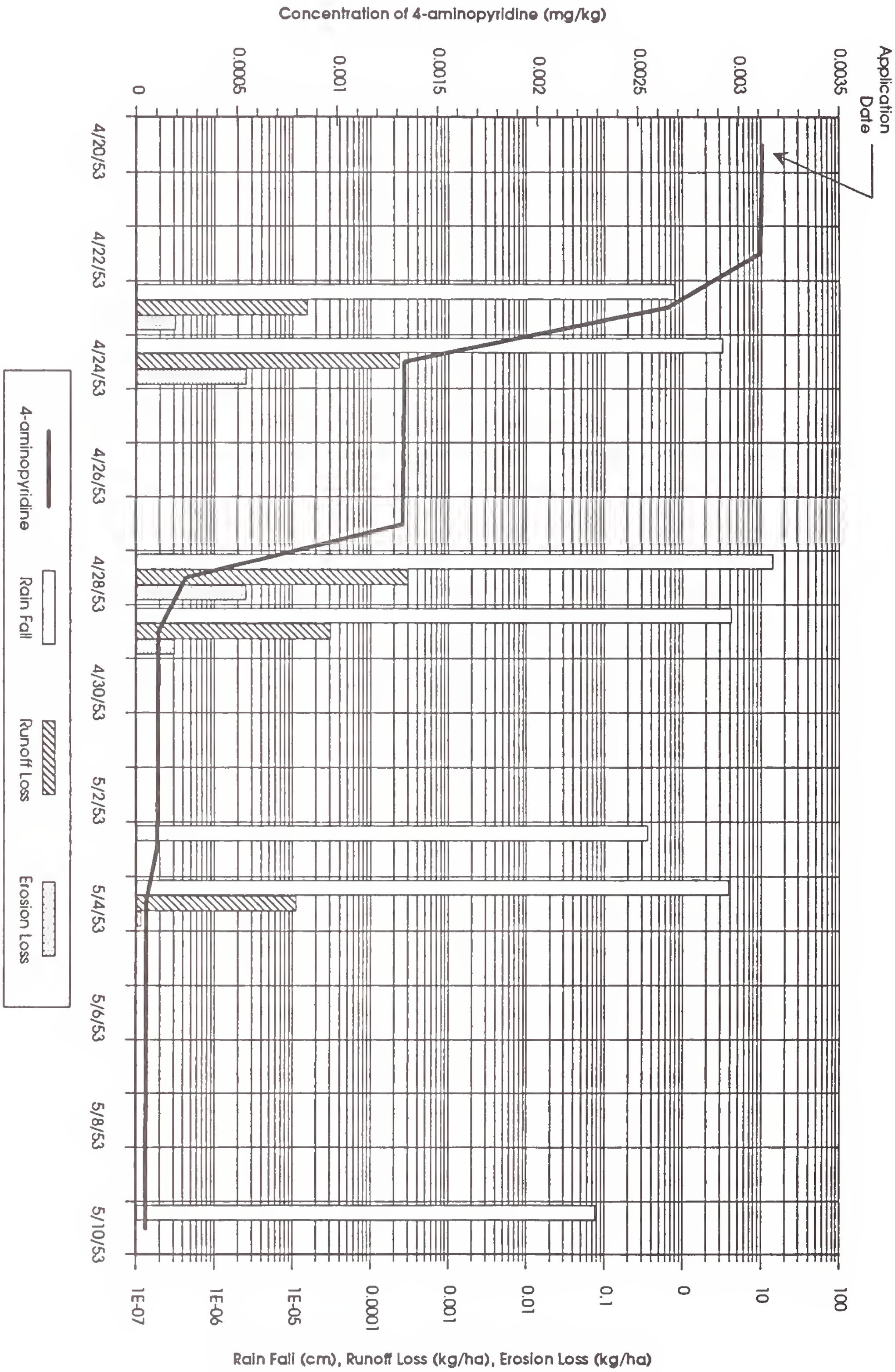


Figure P-5 **Longer-term (90 days) Concentrations in Surface Soil (upper 2cm) of 4-aminopyridine Following Bait Application**

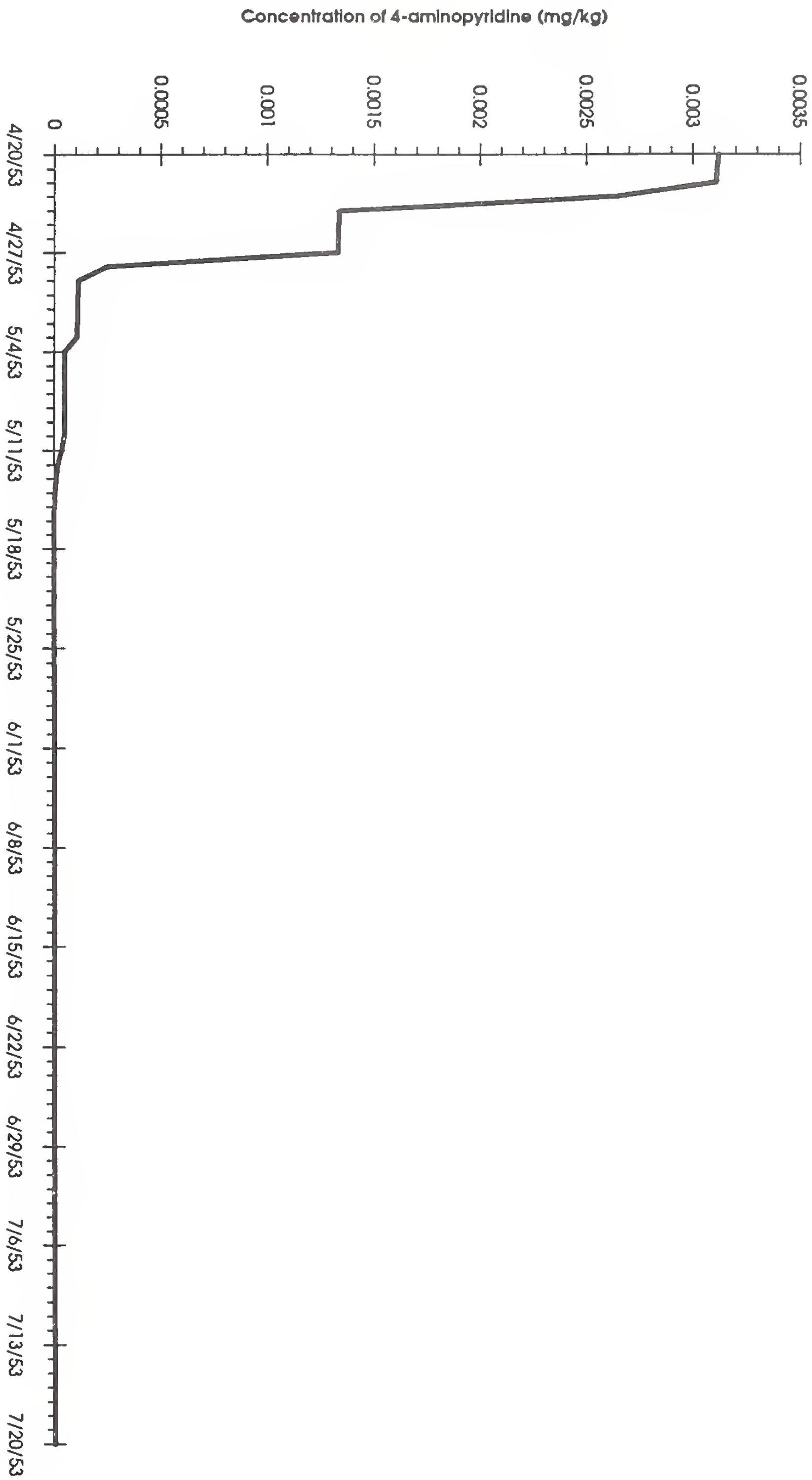


Figure P-6 **Attenuation of 4-aminopyridine Residues in a Hypothetical Pond (water column and benthic sediment) with Time**

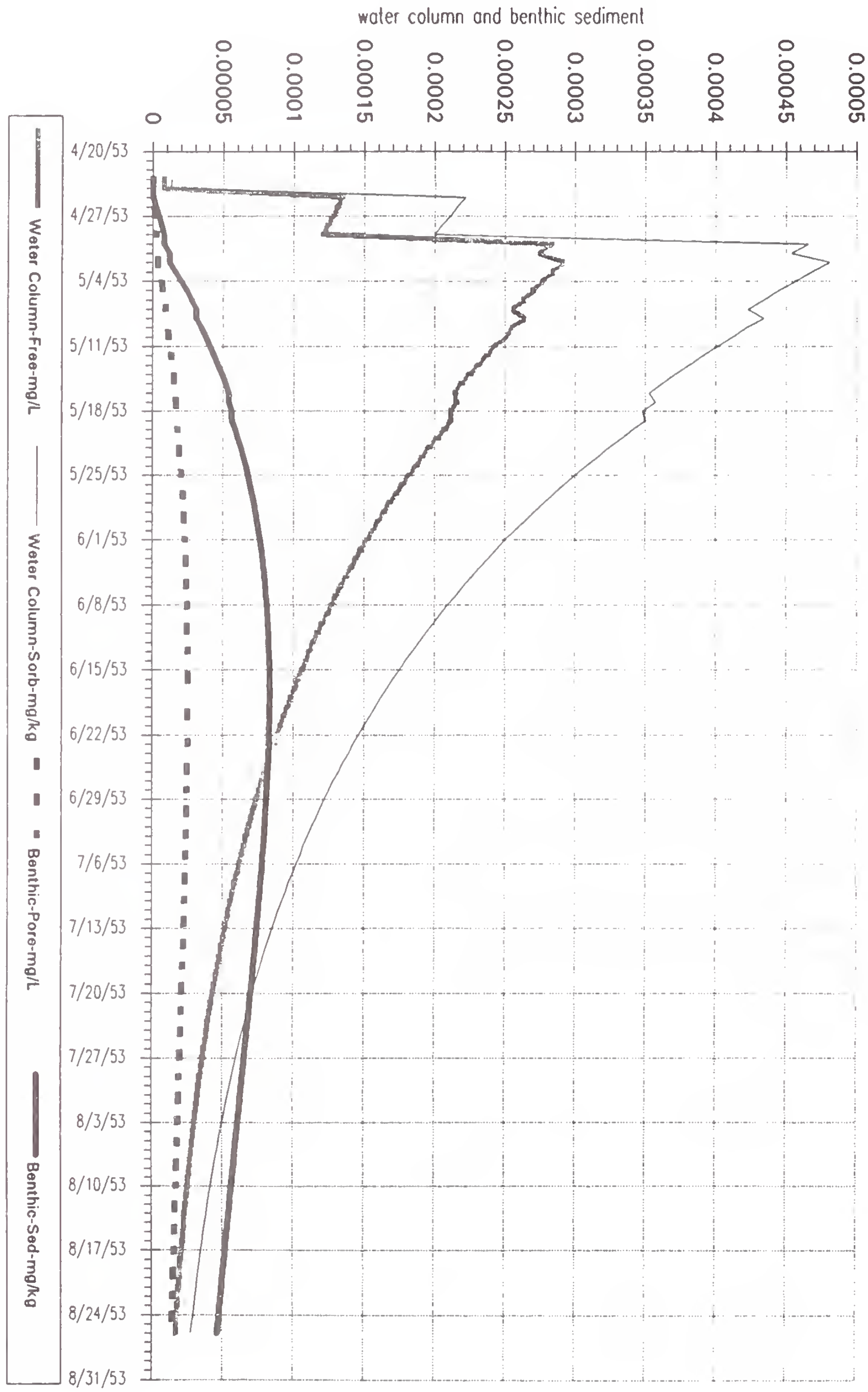


Figure P-7 **Short-term (21 days) Concentrations in Surface Soil (upper 2 cm) and Off-site Transport of DRC-1339 by Storm Events Following Bait Application**

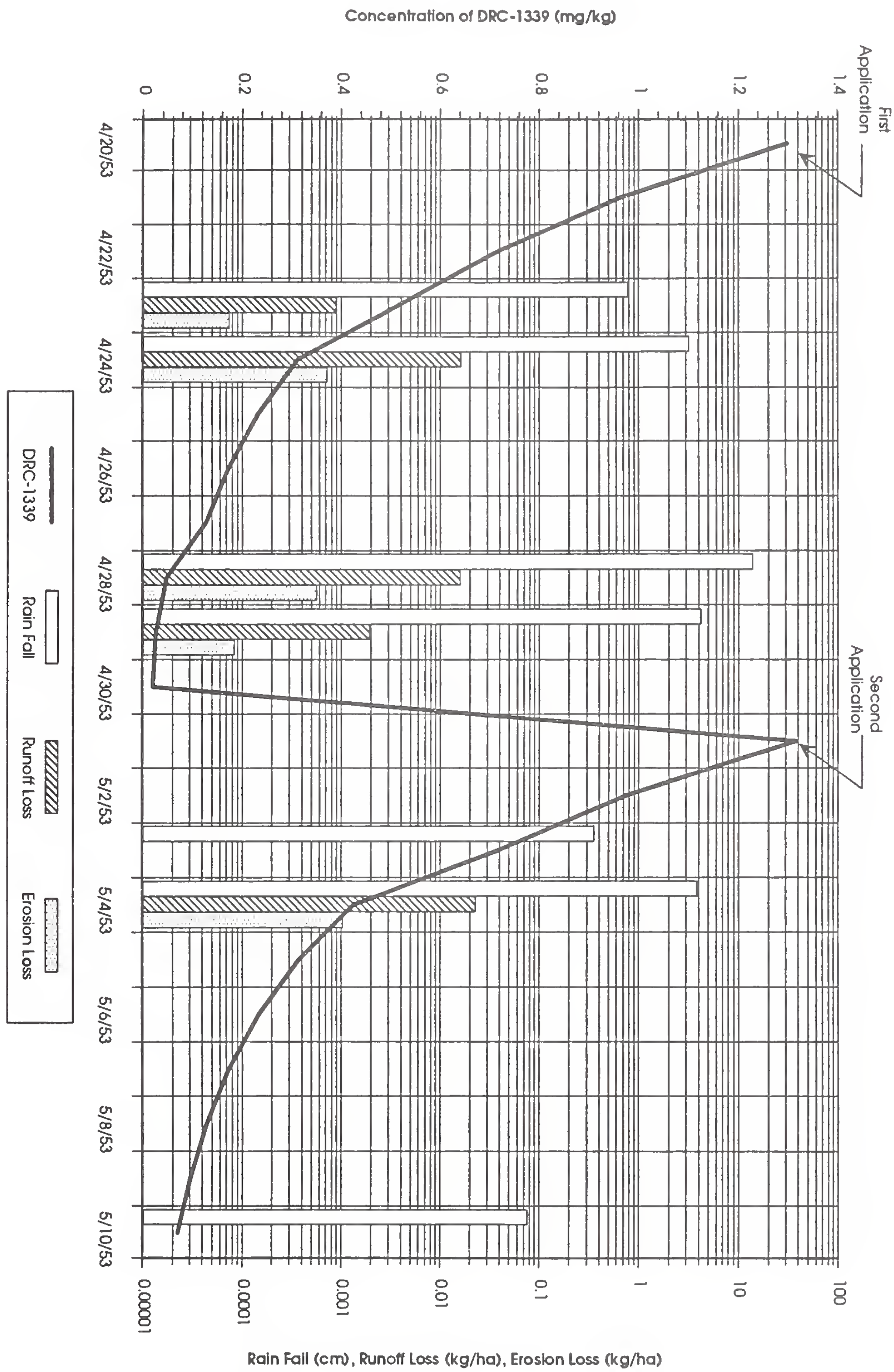


Figure P-8 **Longer-term (30 days) Concentrations in Surface Soil (upper 2cm) of DRC-1339 Following Bait Application**

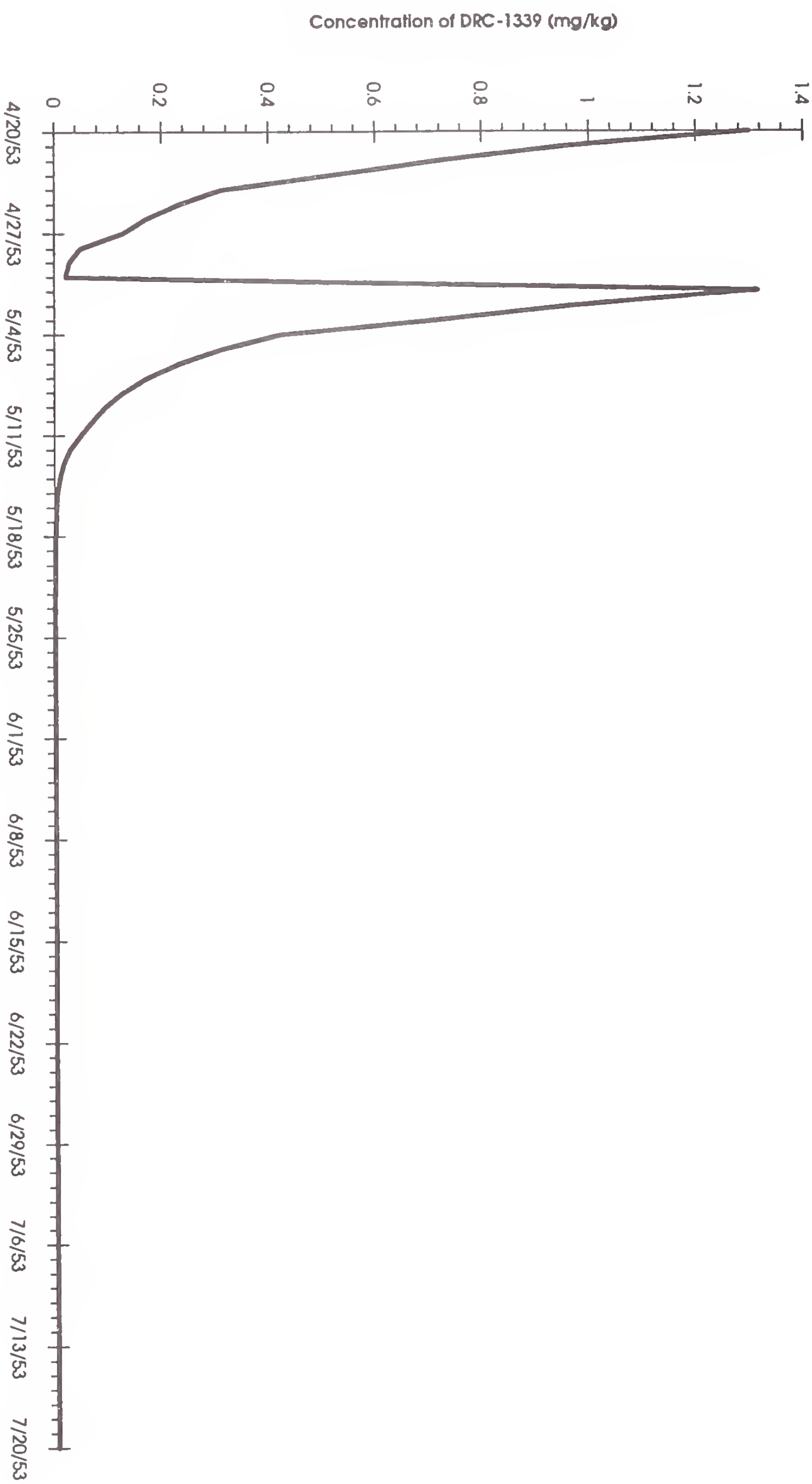


Figure P-9 **Attenuation of DRC-1339 Residues in a Hypothetical Pond (water column and benthic sediment) with Time**

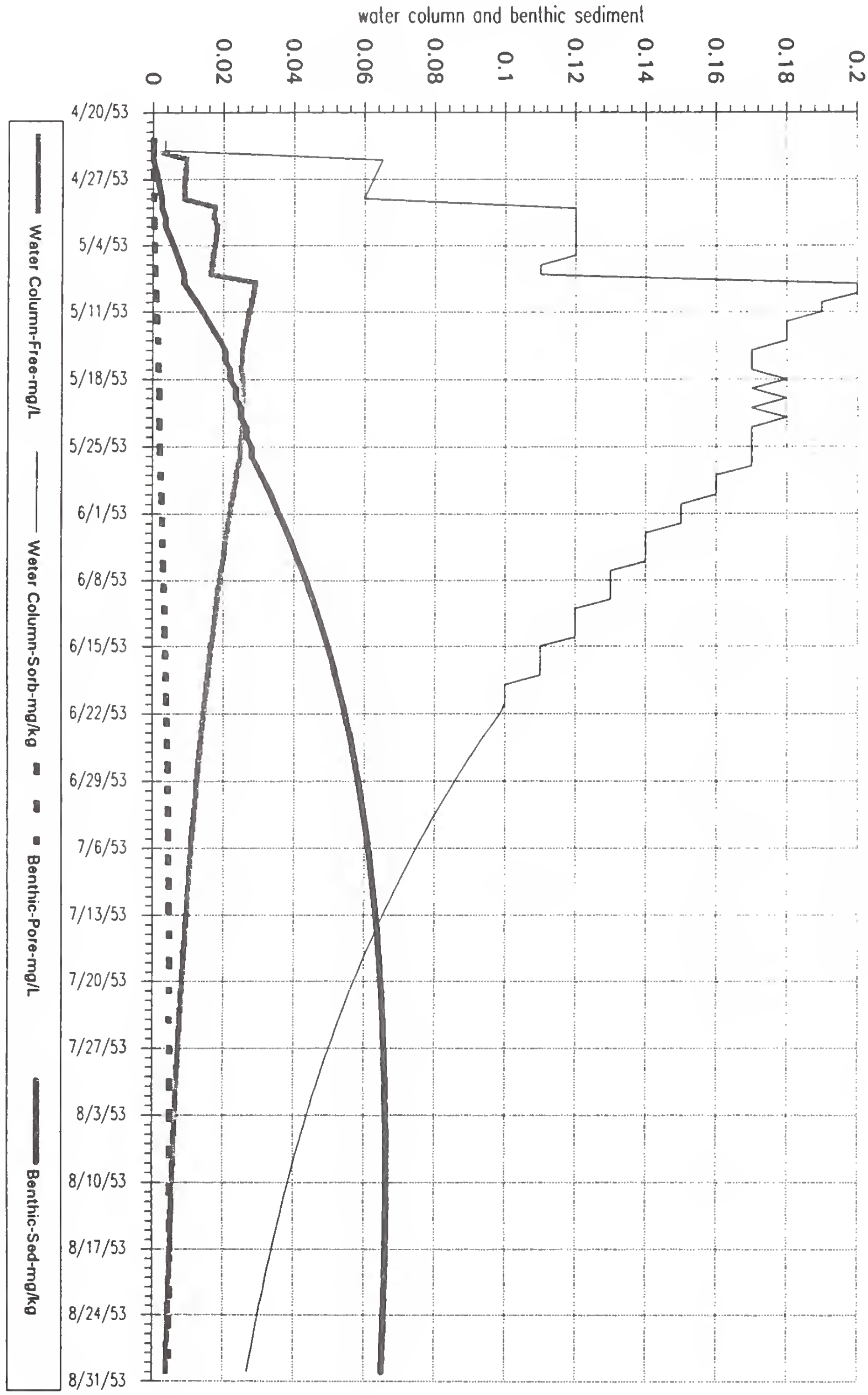


Figure P-10 **Short-term (21 days) Concentrations in Surface Soil (upper 2cm) and Off-site Transport of Strychnine by Storm Events Following Bait Application**

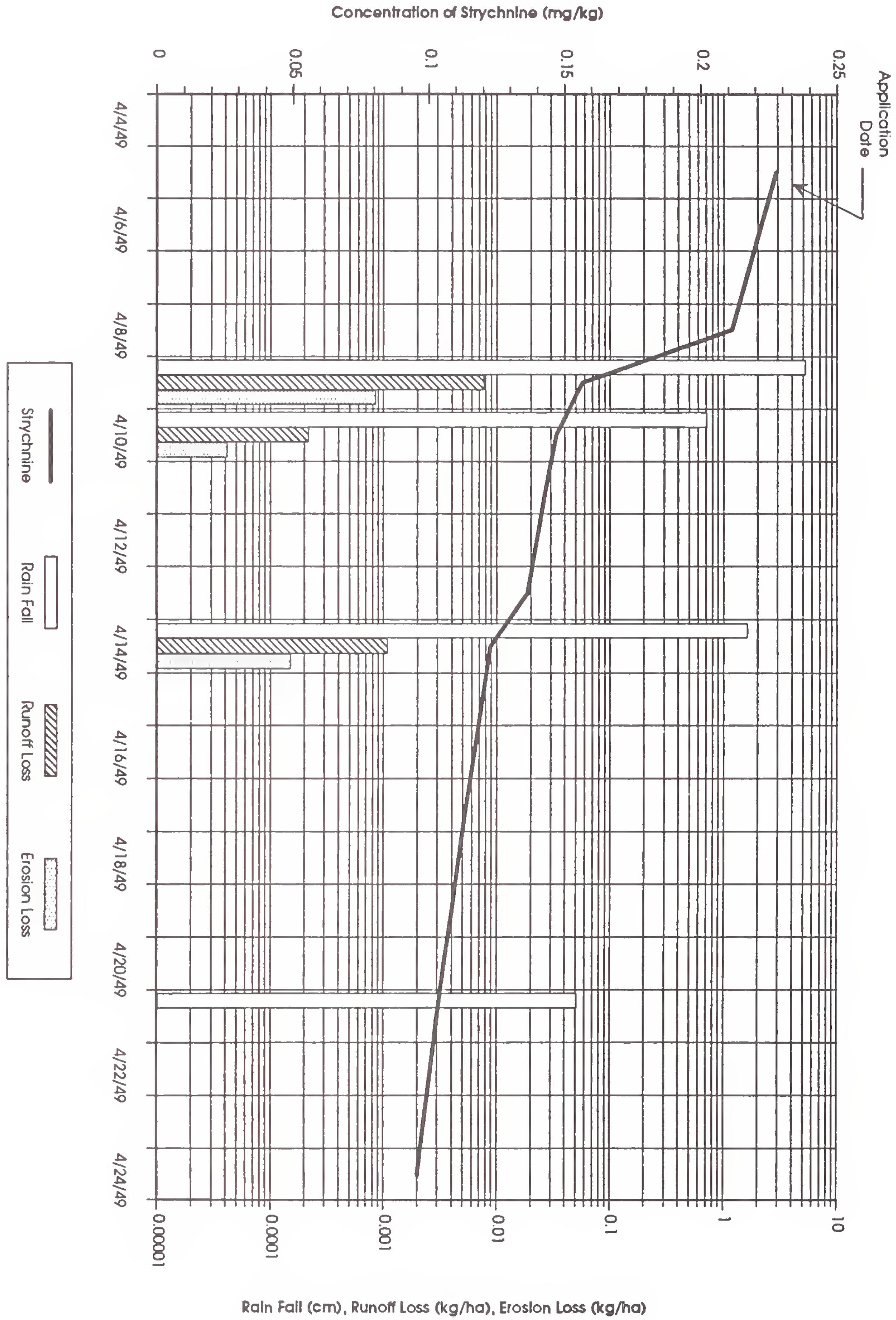


Figure P-11 **Longer-term (30 days) Concentrations in Surface Soil (upper 2cm) of Strychnine Following Bait Application**

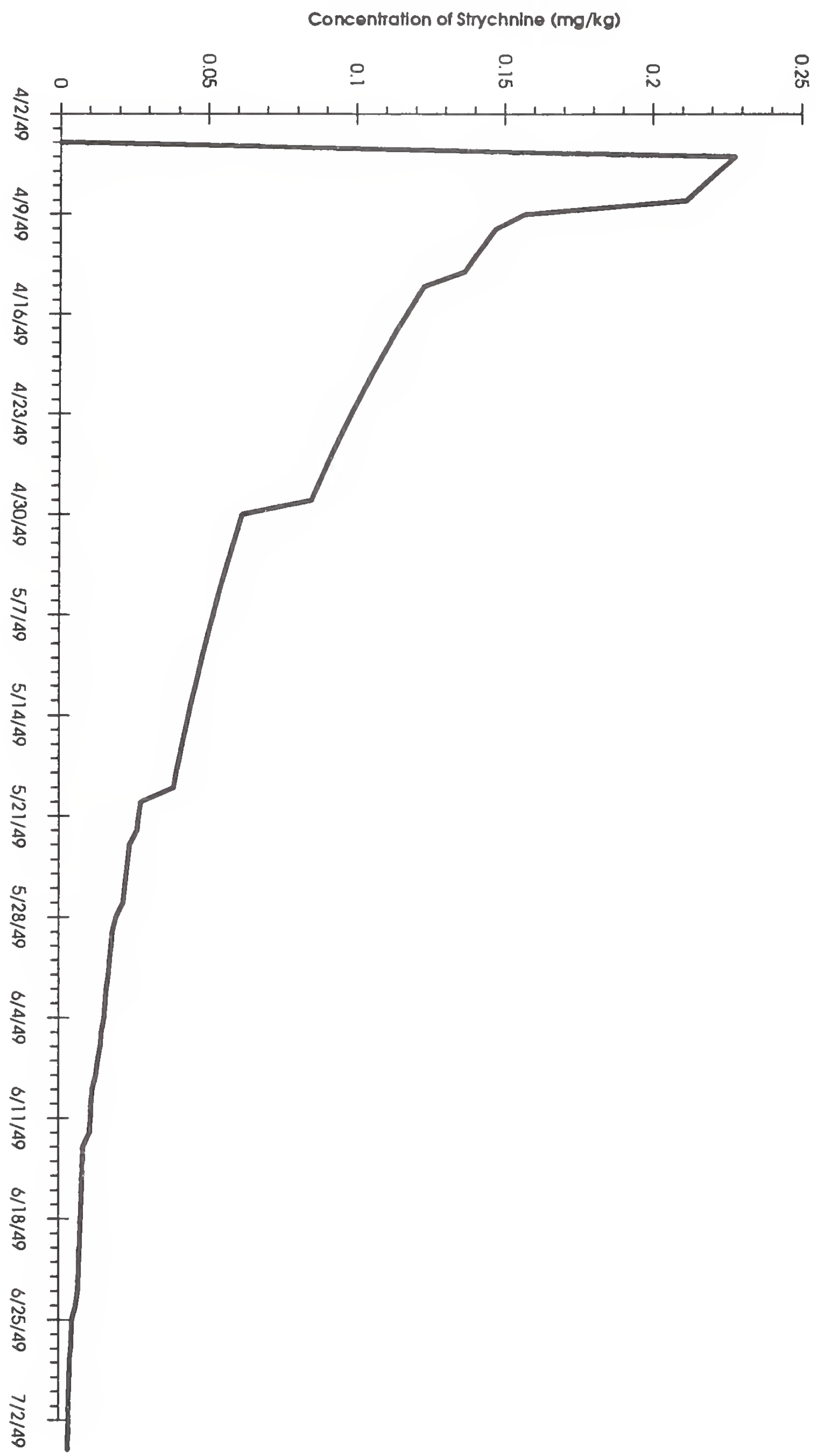
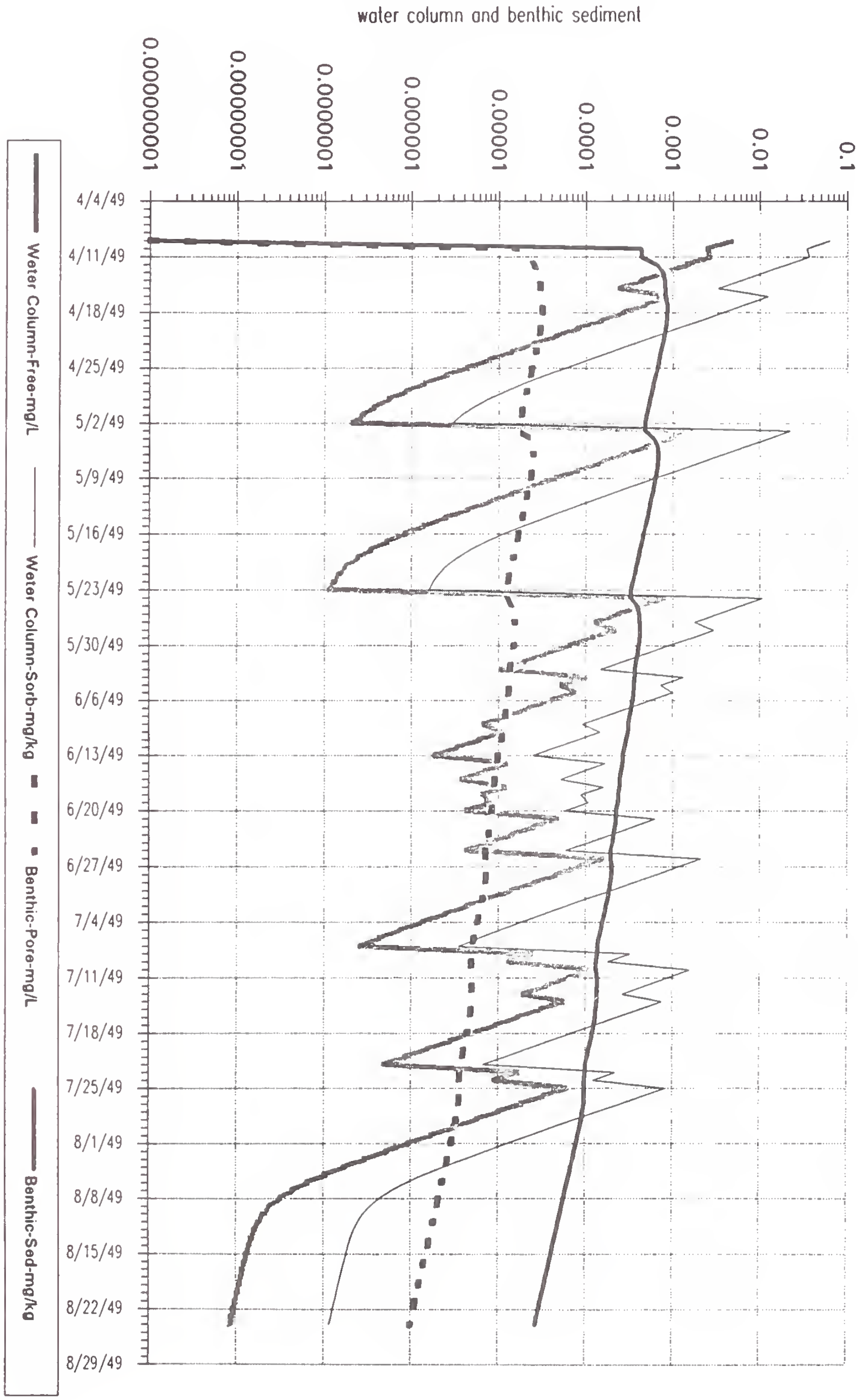


Figure P-12 **Attenuation of Strychnine Residues in a Hypothetical Pond (water column and benthic sediment) with Time**



organism must be overwhelmed before adverse effects are observed in an organism. As a result, an organism will tolerate a range of concentrations from 0 to some finite value before death or other adverse effects occur.

The dose or intake level at which toxicological effects are observed is referred to as the toxicological threshold. Benchmark values represent sub-threshold chemical intakes over an acute, chronic, or subchronic time duration, referred to in toxicological terms as the No Observed Adverse Effects Level (NOAEL). Because toxicological tests are not usually specific enough to represent an entire population or ecosystem, benchmark values are extrapolated from tests using other organisms, target effects (endpoints), or test duration.

Human health toxicologists are routinely confronted with a similar problem in attempting to assess human toxicology (deriving health-protective benchmark values) based on animal studies. Aquatic toxicologists must also address such concerns, although extensive aquatic toxicity information makes such considerations easier. For terrestrial organisms, however, derivation of meaningful benchmark values is difficult because of the absence of data, especially for avian species. Nevertheless, it was necessary to develop an approach in support of the risk assessment, which in some ways is parallel to the approach used in both humans and aquatic toxicology.

The general approach taken to derive benchmark values consisted of identifying a single well-conducted study believed to be representative of other studies. There was no case where findings from several studies were averaged or considered together, rather than adopting a single study for derivation of benchmark values. Averaging of findings from several studies was useful for determining dose-response slopes or other characteristics used in deriving benchmark values.

This analysis included toxicological information for avian, mammalian, aquatic, and secondary toxicity for each active ingredient warranting QRA. Consideration of active ingredients rather than formulated products was appropriate for toxicological considerations because the basic toxicology does not change with formulation. Toxicological benchmarks were determined using sensitive species that are physiologically similar or taxonomically related to the indicator species. Extrapolations from the common test species from which toxicity values were derived were performed based on the uncertainty factors documented in the following section.

(a) Development of Uncertainty Factors

Mammalian receptors. Typically in human health extrapolations a factor of 10 is used to account for variation among individuals, interspecies extrapolation (i.e., using a surrogate species to represent another related species), subchronic to chronic extrapolation, and endpoint extrapolation (LOAEL to NOAEL) (USEPA 1989g). In addition, a modifying factor (1 to 10) is applied based on completeness of the data base or professional judgment. Lewis et al. (1990) evaluated numerous studies regarding toxicological extrapolations from animals to humans in an effort to determine more representative uncertainty factors. The studies reviewed by Lewis et al. (1990) suggested variable uncertainty factors, as follows:

- Based on 490 LD_{50} studies, a factor of 3 to 6 was adequate to adjust for intraspecies extrapolations (Hill et al. 1975).
- For acutely toxic agents, humans may be an order of magnitude more sensitive than animals, but more prolonged or repeated exposure suggests that humans may be no more than 2 to 4 times more susceptible (Lewis et al. 1990).

Table P-23

Toxicological Benchmarks and Uncertainty Factors for Pesticides for Which QRA was Conducted

		Nontarget Receptor		Selected Study (Studies)		
Pesticide	Indicator Species or Group	Adverse Effect	Surrogate Species or Group	Test Type	Value	Units
Avicides						
4-Aminopyridine (Avitrol)	Attwater prairie chicken		coturnix quail	NOEL	4.3	mg/kg-d
	eastern meadowlark	acute	starling	LD_{50}	4.9	mg/kg
	eastern meadowlark	chronic	starling	25 d NOEL	1.8	mg/kg-d
	American crow	acute	grackle/magpie	LD_{50}	2.08	mg/kg
	American crow	chronic	grackle/magpie	LD_{50}	2.08	mg/kg-d
	American kestrel	acute	american kestrel	LD_{50}	5.6	mg/kg
	American kestrel	chronic	american kestrel	NOEL	6.05	mg/kg-d
	freshwater fish	acute	glass shrimp	LC_{50}	0.37	mg/L
	freshwater fish	chronic	glass shrimp	LC_{50}	0.37	mg/L
DRC 1339	northern cardinal	acute	starling	LD_{50}	3.2	mg/kg
	northern cardinal	chronic	starling	90d LD_{50}	0.3	mg/kg-d
	American kestrel	acute	marsh hawk	LD_{50}	100	mg/kg
	American kestrel	chronic	marsh hawk	LD_{50}	100	mg/kg
	golden eagle[a]	for egg and meat bait only (uses benchmark for kestrel)				
	coyote[a]	acute	dog	LD_{50}	71	mg/kg
	coyote[a]	chronic	dog	LD_{50}	71	mg/kg
	freshwater fish	acute	daphnia	EC50	1.6	mg/L
	freshwater fish	chronic	daphnia	EC50	1.6	mg/L
Fenthion	house finch	acute	blackbird	derm LD_{50}	2.4	mg/kg
	house finch	acute	house finch	LD_{50}	10	mg/kg
	house finch	chronic	bobwhite quail	5 d. LD_{50}	3.3	mg/kg-d
	American kestrel	acute	american kestrel	lethality	1	mg/kg-d
	American kestrel	chronic	american kestrel	lethality	1	mg/kg-d
Strychnine	lark species	acute	sparrow	LD_{50}	4.18	mg/kg
	lark species	chronic	mallard[b]	NOEL	8.75	mg/kg-d
	American kestrel	acute	golden eagle	LD_{50}	5	mg/kg
	American kestrel	chronic	golden eagle	LD_{50}	5	mg/kg
	deer mouse	acute	rat	LD_{50}	3.7	mg/kg
	deer mouse	chronic	rat	LOEL	2.5	mg/kg-d
	coyote	acute	coyote	LD_{50}	0.7	mg/kg
	coyote	chronic	coyote	NOEL	1.44	mg/kg-d
	freshwater fish	chronic	bluegill	NOEC	0.31	mg/L
Rodenticides						
Aluminum Phosphide	NM ridgenose rattlesnake	lethality	rat	chronic NOEL	0.03	mg/kg-d
Sodium nitrate, gas cartridge	mtn. beaver/prairie dog	lethality	rat	NOEL	400	mg/liter (mg/kg)
Strychnine	*see Avicides*					

(Continued)

Uncertainty Factors					
Data Quality	Interspecies Variablity	Endpoint Sensitivity	Endpoint Extrapolation	Benchmark Value	UF
1	2	1	1	2.15	2
1	5	3	1	0.33	15
1	5	2	1	0.18	10
1	5	3	1	0.14	15
1	5	3	2	0.07	30
1	1		5	0.37	15
2	1	2	2	0.76	8
1	2	3	2	0.03	12
1	3	3	5	0.01	30
1	5	3	1	0.21	15
1	5	2	3	0.01	30
3	5	3	1	2.22	45
3	5	3	5	0.44	225
2	5	5	2	0.71	100
2	5	5	5	0.28	250
1	2	3	2	0.13	12
1	2	3	3	0.09	18
1	2	2	2	0.30	8
2	1	3	2	0.83	12
2	5	5	3	0.02	150
2	1	5	2	0.05	20
2	1	5	5	0.02	50
3	5	3	1	0.09	45
1	7	2	1	0.63	14
2	5	3	2	0.08	60
2	5	3	5	0.03	15
3	3	5	2	0.04	90
1	3	2	2	0.21	12
1	1	5	2	0.07	10
1	1	2	1	0.72	2
2	2	1	1	0.08	4
1	5	3	3	0.0007	45
2	2	2	2	25.00	16

(Continued)

Table P-23 (Continued)

Toxicological Benchmarks and Uncertainty Factors for Pesticides for Which QRA was Conducted

		Nontarget Receptor		Selected Study (Studies)		
Pesticide	Indicator Species or Group	Adverse Effect	Surrogate Species or Group	Test Type	Value	Units
Zinc Phosphide	ring-necked pheasant	acute	pheasant	LD_{50}	8.8	mg/kg
	ring-necked pheasant	chronic	quail	repro effect	0.27	mg/kg-d
	deer mouse	acute	deer mouse	ALD[c]	42	mg/kg
	deer mouse	chronic	rat	NOEL	3.48	mg/kg-d
	freshwater fish	acute	bluegill	LC_{50}	0.062	mg/L
	freshwater fish	chronic	bluegill	LC_{50}	0.062	mg/L
	freshwater fish for zinc	chronic	fish	LC_{50}	0.13	mg/L
Predacides						
Sodium nitrate	*see Rodenticide*					
Sodium fluoroacetate: Compound 1080	black-billed magpie	acute	magpie	LD_{50}	1.2	mg/kg
	bald eagle	acute	golden eagle	Min LD	1.25	mg/kg
	golden eagle	acute	golden eagle	LD_{50}	1.25	mg/kg
	golden eagle	chronic	mallard[b]	EMLD[d]	0.5	mg/kg-d
	black vulture	acute	black vulture	LD_{50}	15	mg/kg
	black vulture	chronic	black vulture	LD_{50}	15	mg/kg
	red fox	acute	desert kit fox	LD_{50}	0.22	mg/kg
	red fox	chronic	desert kit fox	LD_{50}	0.22	mg/kg

[a] These species were investigated for primary affects due to egg and meat baits.

[b] Mallard dose calculated based on maximum feed rate of 140 g/day per bird divided by the average weight of a mallard at 1.2 kg

[c] ALD = Approximate lethal dose, similar to an LD_{50}.

[d] EMLD = effective minimum lethal dose established after 30 day diet (Hudson et al. 1984)

Uncertainty Factors					
Data Quality	Interspecies Variablity	Endpoint Sensitivity	Endpoint Extrapolation	Benchmark Value	UF
1	1	3	2	1.47	6
1	5	2	1	0.03	10
3	3	2	5	0.47	90
1	3	2	1	0.58	6
1	2	3	1	0.0103	6
1	2	3	3	0.0034	18
AWQC	1	1	1	0.058	1
1	1	10	5	0.02	50
4	1	4	5	0.016	80
2	1	3	1	0.21	6
2	5	2	3	0.003	25
1	1	3	3	1.67	9
1	1	3	5	1.00	15
1	2	3	1	0.037	6
1	2	3	3	0.012	18

- Examination of ratios of 52 chronic and subchronic LOAELs to NOAELs revealed a difference of 5 or less (Weil and McCollister 1963).
- Extrapolation from a subchronic to a chronic NOAEL required a factor of 5 about 90 percent of the time (Weil and McCollister 1963).

This study provides reasonable uncertainty factors for animal-human extrapolations and implies that uncertainty factors for similar species need not be large to provide adequately conservative values.

Avian receptors. Bird species may vary greatly and have not been widely studied for many contaminants, such as pesticides (Tucker and Haegele 1971), and thus standardized uncertainty factors have not been developed for the purpose of deriving conservative benchmark values. Nevertheless, every effort was made to use representative studies and species for the endpoint of concern, with uncertainty factors providing additional assurance of conservative benchmark values.

Schafer and Brunton (1979) evaluated whether surrogate species are representative of most avian species. Only a few studies comparing subacute toxicological relationships have been conducted that indicate differing results. For example, Hill et al. (1975) found that passerines were more sensitive than the bobwhite quail, a common test species. The use of the bobwhite quail should then be given greater uncertainty factors when extrapolating to protect passerines.

Schafer and Brunton (1979) also indicated that sensitivity increased as a function of decreasing weight. This corresponds to the fact that the smaller species requires a higher percentage of food to satisfy energy requirements, thus consuming more toxicant per pound of body weight. Balcomb et al. (1983) analyzed the dietary LC_{50} values for 131 pollutants (primarily pesticides) from Hill et al. (1975) and determined a probit dose/response slope of 5.85 (SD = 2.5). This slope of less than 6 indicates a lower variation in toxicity response to many bird species. Tucker and Haegele (1971) compared the toxicity of 16 pesticides to six bird species, including mallard, pigeon, sparrow, chukar, pheasant, and coturnix quail. The average range of difference in the six species LD_{50} was about tenfold. The analysis, however, failed to show any correlation between phylogenetic relationships or toxicologic susceptibility between different species. For example, the ratio for the coturnix and pheasant was higher than the ratio between the less-closely related mallard and pheasant. The study concluded that variability among species was high but that no one species was significantly different from the other (Tucker and Haegele 1971).

USEPA (1991c) noted that interspecies difference in avian mortality to the same chemical ranged from 30 to 60 and that the interspecies difference in avian reproductive effects varied by 300, with only 10 percent of chemicals posing a reproductive threat. In conclusion, these studies indicate that the range of differences among avian species is rather small, suggesting that use of representative avian data and uncertainty factors is an adequately conservative approach.

Surrogate avian test species. Test surrogate species selected represented: (1) the more sensitive species listed in Table P-11; (2) the most reliable data toxicologically; (3) taxonomically similar species; and (4) a smaller species than the more valued indicator species. Selected indicator species and their representative test surrogates are listed in Table P-23.

The principles of avian toxicology discussed above are based on several studies and have been used to derive avian toxicological benchmark values. Table P-24 shows the uncertainty factors based on these principles.

Aquatic receptors. USEPA (1991c) noted the following variability in the range of toxic responses of various aquatic species:

- Species sensitivity. Range varied from 3 - 4 orders of magnitude for acute effects to 1 - 2 orders of magnitude for chronic effects (Sloof et al. 1983, Hansen 1984).

- Endpoint sensitivity. In fish, USEPA (1991c) reported that a difference of no more than six orders of magnitude in median effect concentration can be produced using any known biochemical, histological, or behavioral effect as the endpoint in place of lethality.
- Endpoint extrapolation. Laboratory data for various marine and freshwater species indicate that the extrapolation from acute to chronic studies ranged between ten to forty orders of magnitude (USEPA 1991c).

These principles of aquatic toxicology are based on numerous studies and are useful in deriving aquatic toxicological benchmark values. Table P-23 indicates the types of uncertainty factors used to derive benchmark values supporting this risk assessment.

The above range of uncertainty factors was derived from the studies and general criteria presented previously. Uncertainty for mammals is less than for avian or aquatic species because of the large database available. Values of one were appropriate either when no surrogate species was required or when the desired and test endpoints also represented sensitive NOELs.

Lower values are used for studies that investigated effects or species similar to the endpoint of study for indicator species as shown in Table P-23. No uncertainty factors were necessary when studies satisfied the selected endpoint. For example, if the selected endpoint sensitivity is a NOEL and the available study determined a value that caused no effect, no uncertainty factor is needed. The majority of the studies reviewed used acute toxicity as the basic endpoint type. Use of these data is appropriate for the risk assessment in part because exposure may be limited to shorter durations. Larger UFs were generally used. When acute data were used to derive chronic benchmark values, appropriate acute to chronic UFs were applied (see range shown in Table P-24).

The assignment of UFs varies depending on the particular set of data for a specific chemical. Low UFs represent confidence that the data from the literature matches the toxicological endpoint or species selected for evaluation in this document. For example, the extrapolation of data from an acute study to a chronic study would have greater uncertainty associated with it than an extrapolation from a sub-chronic to chronic study. As shown in Table P-23, each chemical has been assigned a unique set of uncertainty factors for developing benchmarks for a species of concern.

Selection of studies. Studies were evaluated generally following the same criteria as those used by USEPA for determining general quality of studies, including survival of controls, maintaining acceptable testing conditions, and other basic testing requirements. Studies completed as part of registration requirements but not found to be acceptable according to USEPA Good Laboratory Practices (GLP) standards were not used in deriving toxicological benchmark values.

Calculation of uncertainty factors. Following selection of the key study, the uncertainty factors for each chemical and each target organism were calculated according to the equation:

Benchmark Value = (Selected Study Value)/(UF1 x UF2 x . . . . x UFn)

Toxicological benchmark values are designed to be conservative in estimating potential toxicity to species potentially exposed to the pesticide. A discussion of key toxicological properties of the QRA pesticides used in direct control by APHIS ADC and the rationale for deriving benchmark values are provided in the compound-specific analysis. Table P-11 also provides an overview of toxicological properties of all compounds considered for the risk assessment.

(2) Inerts

The risk assessment included an evaluation of inert ingredients, including surfactants, adjuvants, carriers, and emulsifiers, within APHIS ADC formulated products, consistent with USEPA policy under FIFRA (1988, definition in Section 2(m)), to determine whether such ingredients could present or contribute to adverse nontarget exposures. This evaluation was conducted by reviewing literature pertaining to the products and interviewing scientists involved with chemical methods.

Results of the evaluation indicated that APHIS ADC has taken measures in response to USEPA policy to remove inerts of potential concern. For example, the M-44 cyanide capsule formerly contained a cadmium compound, Tracerite, as a marker. Following a data call-in for cadmium, APHIS ADC replaced the Tracerite marker with a nontoxic plastic pigment. The review of the current chemical methods disclosed other examples of formulation changes to comply with USEPA policy on inerts as well.

d. Risk Characterization

(1) Overview of Process

It is the general intent of the risk assessment to address potential effects to both individual organisms and populations and ecological communities as well, although the basic approach has focused on protection of individual humans and nontarget wild animals.

Table P-24

Uncertainty Factors Used to Extrapolate QRA Dose-Response Data

	Uncertainty Factor		
Category	**Mammalian**	**Avian**	**Aquatic**
Completeness of data base or toxicology studies	1-3	1-3	1-3
Interspecies variability:			
Similar taxonomically or physiologically	1-3	2-10	1-10
Dissimilar taxonomically or physiologically	2-5	2-10	1-25
Endpoint sensitivity:			
Subchronic to chronic	1-5	1-5	1-6
Acute to chronic	2-10	2-10	5-10
Endpoint Extrapolation:			
Similar effects	1-5	1-5	1-5
Dissimilar effects	2-10	2-20	2-20

Under the provisions of the Endangered Species Act, individual threatened or endangered organisms must be protected because of their limited abundance. For nonlisted indicator species it is appropriate to consider the potential effects to overall populations and ecological communities. The discussion below provides an overview of key assumptions adopted to characterize risk to specified receptors.

The general approach to the exposure and dose-response (toxicological) assessment, detailed above, is based on the following assumptions:

- Exposure to nontargets occurs in the same manner it does to target organisms (this allows use of the generally plentiful pesticide efficacy data).
- Acute exposure of targets or nontargets to chemical methods is proportional to the fraction of a State in which application occurs.
- Available environmental fate data (generally developed for soils in support of USEPA-required registration data) are representative of expected behavior of pesticide residues in bait following application.
- Acute and chronic toxicological benchmark values are representative of nontarget organism sensitivity to active ingredients of the QRA products.
- Indicator organisms (including T&E species) were selected to overstate rather than understate potential exposure to nontargets.
- It is possible to represent the geographic area in which application occurs based on use pattern data. As noted previously, the geographic unit of analysis is assumed to be a State.

All end-use formulations warranting QRA were addressed on the basis of both acute and chronic exposures, albeit in a slightly different manner. Both portions of the risk assessment addressed each pathway of potential concern, although uncertainty may be greater in the chronic than the acute portion because much more data (e.g., pesticide efficacy data) is available for the latter. The risk characterization by compound discusses potential nontarget hazard or risk associated with each product and the sources and relative contributions of uncertainty within the analysis.

(2) Risk Characterization by Compound

(a) Risk Characterization for Pesticides Found to Have Minimal Off-Site Transport Potential

Aluminum phosphide, sodium nitrate, and sodium cyanide were determined to exhibit minimal potential for off-site transport based on both environmental properties and use pattern characteristics.

Fenthion; 4-aminopyridine (Avitrol 25% concentrate); DRC-1339, 98% gull toxicant; and Compound 1080 were also determined to exhibit minimal potential for off-site transport, but only on the basis of use pattern characteristics. If less restrictive applications were used by APHIS ADC for these compounds, off-site transport potential would have to be re-evaluated.

(b) Risk Characterization for Pesticides Found to Have Significant Off-Site Transport Potential

This section presents the results of combining exposure-point concentrations with toxicity data for those compounds where exposure pathways were defined and quantified with reference to off-site transport potential. As earlier defined, these compounds include 4-aminopyridine (0.5 percent a.i.), DRC-1339 98 percent (except the Gull toxicant), strychnine (all avian and rodent formulations), both fenthion formulations, zinc phosphide formulations (except #56228-7 for rat control), and Compound 1080 LPC. Neither

fenthion nor sodium fluoroacetate were analyzed for off-site transport potential as noted above; therefore no aquatic hazards were addressed. The end-use formulations characterized for off-site transport are listed below.

- 4-Aminopyridine (Avitrol), 0.5 percent.
- DRC-1339, 98 percent, feedlots and Starlicide Complete, 0.1 percent.
- DRC-1339, 98 percent, structures.
- DRC-1339, 98 percent, staging areas (representative scenario).
- DRC-1339, 98 percent, eggs/meat bait.
- Fenthion (Rid-A-Bird), 11 percent and (BCF#1) 9 percent.
- Strychnine (Pigeon Bait Strychnine Corn, 0.4 percent; Sparrow-cracks, 0.6 percent; and Bird Toxicant, 0.35 percent).
- Strychnine (Steam-Rolled Oats), 0.5 percent; (Milo), 0.35 percent (both above and below ground; representative scenario).
- Strychnine, 1.6 percent and 4.9 percent, paste.
- Strychnine, 5.79 percent, salt block.
- Zinc Phosphide Concentrate for Mouse Control, 63 percent.
- Zinc Phosphide Concentrate for Muskrat and Nutria Control, 63 percent.
- Zinc Phosphide, 2 percent ZP Rodent Bait AG (representative scenario) including D&H Formula Rodent Rid-R, Rodent Bait, Steam-Rolled Oats, 2 percent and on Wheat, 1.82 percent.
- Sodium fluoroacetate, Compound 1080.

(c) Sources of Uncertainty

Considerable uncertainty is inherent in this risk assessment, although it is designed to err on the side of conservatism. The purpose of this section is to identify and evaluate the principal sources and relative magnitudes of this uncertainty. Quantitative techniques used to determine magnitudes of uncertainty are discussed below.

The two primary sources of uncertainty in the analysis include the assumptions used to support the exposure assessment (e.g., exposure factors, delineation of pathways, use pattern information, nontarget receptor information) and toxicological considerations (e.g, errors in reporting toxicological and environmental fate information). Each of these sources is expected to contribute to varying degrees to uncertainty within the risk assessment.

Exposure Assessment Uncertainty. Indicator organisms used in the risk assessment are designed to represent the most sensitive, vulnerable, or exposed species (or individuals within that species). Similarly, the exposure factors used to support the analysis are uncertain, based on empirical observation or best professional judgment, but all are adequately conservative. It is therefore unlikely that an organism more sensitive than the indicator species would be present at the site of application more frequently than specified.

Less uncertainty is expected in delineating the four key potential exposure pathways addressed in the analysis (primary ingestion of bait, secondary ingestion of prey, ingestion of soil, exposure to surface water), although considerable uncertainty exists in developing exposure point concentrations for receptors potentially exposed via specific pathways. However, all calculations were performed conservatively using the RME approach and as such are unlikely to underestimate actual exposures.

Toxicity Assessment Uncertainty. Considerable uncertainty exists in the acute and chronic toxicological benchmark values derived to quantify potential risk. This uncertainty is a function of variability in previous studies (e.g., concentrations/doses tested,

accuracy of observations) and in the application of UF values to derive benchmark values. The latter source is expected to contribute more substantially to overall uncertainty. Uncertainty factors such as those applied to individual studies to derive benchmark values for human health and aquatic toxicity have been standardized and rigorously reviewed for protection of human health and aquatic life. Such standardization has not yet occurred for benchmark values for wildlife. In general, toxicological assumptions were intended to be conservative and are not expected to underestimate potential acute or chronic toxicity.

Another potential source of uncertainty is inherent in the toxicokinetic parameters, such as gastrointestinal and dermal absorption of contaminants. The risk assessment assumed that rates of absorption occurring in the laboratory would generally be the same as those in the wild. This represents a highly conservative assumption, because both the test compounds themselves and the media (carriers) in which they are administered are almost always more controlled than what actually occurs in the wild (e.g., residues occurring in soils, flesh, etc.), which frequently contributes to lower rates of absorption (Poiger and Schlatter 1980; USEPA 1990e). Accordingly, it is highly unlikely that values assumed for the risk assessment could underestimate actual internal absorption.

(d) Uncertainty Analysis

Given the sources of uncertainty noted above, this section will analyze and, where appropriate, quantify uncertainty within the risk assessment. The discussion focuses on uncertainty by individual pathway type, because this approach represents a useful means by which the subject of uncertainty can be meaningfully approached and potentially quantified. The four pathways that were quantitatively evaluated in the risk assessment include primary ingestion of bait, secondary ingestion of prey, incidental ingestion of soil, and potential exposure to surface water. Of these four pathways the latter two (incidental ingestion of soil and potential exposure to surface water) were most amenable to quantification. Reasons for this include:

- Evaluation of hazard associated with primary ingestion of bait is best evaluated based on retrospective analysis, defined as the likelihood that a nontarget could ingest hazardous amounts of bait based on past observation and known behavior patterns.
- Evaluation of secondary hazard associated with ingestion of prey remains (including carcasses of animals that died from primary intoxication) is not amenable to quantification for many of the same reasons, and the techniques available for quantifying such exposures were not applicable because none of the QRA actives are known to bioaccumulate.
- Evaluation of hazard relating to incidental ingestion of soils was performed conservatively using a field-validated, USEPA-approved numerical model, which is highly amenable to conducting sensitivity analyses using multiple runs of the model.
- Evaluation of hazard relating to surface water exposures was also performed using a field-validated, USEPA-approved numerical model that is amenable to conducting sensitivity analyses using multiple runs of the model.

Based on this rationale, it was not considered appropriate to quantify uncertainty for primary ingestion of bait and secondary ingestion of prey, while uncertainty was quantified for incidental ingestion of soils and surface water exposures. The following uncertainty/sensitivity analysis refers to the detailed discussion and assumptions provided in the quantitative exposure assessment.

Uncertainty analysis for soil and water pathways. There are four major sources of uncertainty in predicting EECs of pesticides in surface soil and water, including: (1) climate conditions (e.g., rainfall, wind speed, temperature), (2) environmental properties (e.g., soil erodibility factor, organic carbon content in the pond), (3) pesticide properties (e.g., pesticide degradation rate, soil sorption coefficient, vapor pressure), and (4) pesticide use pattern information (e.g., application rate, frequency).

It is important to determine the effect of uncertainties in rate constants and other parameters on predicted EECs and to ascertain which parameters are most influential. In this section, a quantitative uncertainty (or sensitivity) analysis is conducted to determine the relative importance of parameters considered to potentially influence these EECs.

Results of the DRC-1339 quantitative exposure assessment for surface soil (using PRZM) and for surface water (using EXAMS) are used as appropriate examples for conducting this analysis. This active ingredient was selected to represent the others in the uncertainty analysis, because: (1) it is among the most mobile of the QRA pesticides examined; (2) considerable nontarget hazard is possible based on the relatively high order of acute and chronic toxicity; and (3) it is perhaps the most widely used of the APHIS ADC QRA pesticides. Other compounds were carefully considered, but did not meet all three criteria and were therefore not subjected to the quantitative uncertainty analysis.

Sensitivity analysis has been defined by Havens and Fontaine (1991) as the determination of change in the model response (output) to modification in model parameters and specification (inputs). Several methods of sensitivity analysis have been described by Havens and Fontaine (1991), summarized as: (1) classical response surface methods; (2) statistical sampling methods; (3) Fourier amplitude sensitivity testing (FAST); and (4) differential methods. Methods (2) and (3) can be used to sample the entire parameter range because the robust data set established for the purpose of exposure modeling is appropriate for conducting the sensitivity analysis. Global sensitivity, defined as parameter sampling over an entire range of variability, is also obtained using these methods, although this level of sensitivity was not always obtained during the analysis.

A probability modeling approach was developed by DowElanco (Laskowski et al. 1990) through use of PRZM as its central component, along with FAST and Monte Carlo sampling techniques. The PRZM model, a weather generator (Richardson and Wright 1982), and USDA/SCS soil survey data base (Oliver and Laskowski 1984) serve as input to the model; output is the corresponding distribution of results as dictated by input distributions within PRZM. This state-of-the-art model is useful for assessing environmental impacts of chemicals due to its ability to consider the whole range of variability for each PRZM input parameter coupled with sensitivity analysis. The model has been validated for various leaching problems (Laskowski et al. 1990, Havens and Fontaine 1991). However, no validation for surface runoff problems is known (Fontaine 1992).

A comparison of global and local sensitivity analysis (i.e., using differential methods) conducted for PRZM modeling by DowElanco (Fontaine 1992) suggested a high level of consistency between methods. These results suggest that a simplified differential method (local sensitivity analysis) would be appropriate for the APHIS ADC risk assessment. A simplified differential method was therefore performed for the PRZM and EXAMS models to predict EECs of DRC-1339 in surface soil and water as a function of key input parameters.

PRZM Sensitivity Analysis. The intent of this analysis was to evaluate changes in surface soil concentrations and off-site transport of DRC-1339 as a function of changes in values of some key parameters used for modeling with PRZM. The base case of this sensitivity analysis is defined as the representative scenario for PRZM modeling. Seven key parameters were considered in the sensitivity analysis, each of which was compared with the base case. Table P-25 provides a summary of the key parameters analyzed, including the results. Parameters tested include the following:

- Base Case: the representative scenario.
- Case 1: the annual rainfall was increased by 30 percent above the base year and increased rainfall was evenly distributed throughout the simulation year (at 0.097 cm/day).

- Case 2: the annual rainfall was increased by 30 percent above the base year, and increased rainfall was evenly distributed throughout the first month following application (at 1.183 cm/day); precipitation during the other 11 months remained the same as the base year.
- Case 3: runoff curve number was decreased from the base value of 94/91/93 to a permutation value of 72/70/72.
- Case 4: erodibility factor was increased 30 percent from the base case value of 0.19 to a permutation value of 0.25.
- Case 5: soil half-life was increased 30 percent from the base case value of two days to a permutation value of 2.6 days.
- Case 6: K_{oc}/K_d value was increased 30 percent from the base case value of 137/3.18 to a permutation value of 178/4.13.
- Case 7: application rate was increased 30 percent from the base case value of 0.56 kg/ha to a permutation value of 0.73 kg/ha.

PRZM modeling was conducted to simulate the surface soil concentrations and off-site transport from runoff and erosion using the permutation value for each case. Figures P-13A to P-13C graphically present the comparison of base case output (i.e., surface soil concentrations of DRC-1339) with the output of each permutation case. Output concentrations of permutation cases at day 5 and day 20 following application are also included in Table P-25. The percent of change for these concentrations was then calculated and is also presented in this table. In addition, the relative sensitivity was ranked for each permutation parameter based on percent of concentration change. Table P-25 also includes the results of annual cumulative runoff and erosion of DRC-1339, percent of concentration change, and the relative sensitivity ranking for each permutation parameter.

The results shown in Figures P-13A to P-13C indicate that the concentrations of DRC-1339 in surface soil are sensitive to increased rainfall during the month following application (Case 2), soil half-life (Case 6), and application rate (Case 7), but relatively less sensitive to annual rainfall change (Case 1), soil runoff curve number (Case 3), erodibility factor (Case 4), and soil adsorption coefficient K_{oc}/K_d (Case 6).

Sensitivity analysis results also indicate that soil half-life appears to have the greatest effect on surface soil concentrations of DRC-1339 among the seven parameters evaluated. Increasing the soil half-life value by 30 percent caused a 73 percent increase in surface soil concentration 20 days after application. Rainfall during the month following application appeared to have a significant effect on surface soil concentrations, and the impact of this factor appeared to increase with time. Application rate also appeared to have a significant effect on surface soil concentrations. A 30 percent increase in application rate caused an approximate 30 percent increase in concentration both at day 5 and day 20. A 30 percent increase of K_{oc}/K_d caused less than 5 percent change in surface soil concentrations at both day 5 and day 20. The effects of annual rainfall were relatively less important. A 30 percent increase in annual rainfall yielded an increase of less than 2.5 percent in soil concentration. Runoff curve number and soil erodibility factor were the least sensitive parameters.

Results of the sensitivity analysis for off-site transport indicated that rainfall during the month following application evenly distributed during the year (Case 2) and soil runoff curve number (Case 3) were the most sensitive parameters. This is an important conclusion. It suggests that to minimize off-site transport of DRC- 1339, application should not be made during the rainy season or on soil which favors runoff.

Soil half-life and application rate also appear to have a significant effect on off-site transport of DRC-1339, while change in annual rainfall (Case 1) and K_{oc}/K_d (Case 6) appear to have an effect on off-site transport, albeit to a lesser degree. The soil erodibility factor did not appear to affect DRC-1339 runoff, but did appear to affect erosion of DRC-1339.

EXAMS Sensitivity Analysis. The intent of this analysis was to evaluate changes of DRC-1339 concentrations in surface water (hypothetical pond) as a function of change in some key parameters used for modeling with EXAMS. As with PRZM, the base case for the sensitivity analysis is the representative scenario. Six key parameters were considered for the sensitivity analysis. Table P-26 provides a summary of the key parameters analyzed, including the results. Parameters tested include the following:

- Base Case: the representative scenario.
- Case 1: vapor pressure was decreased 30 percent from the base case value of 1.06E-4 torr to permutation value of 7.28 E-5 torr.
- Case 2: first order biodegradation rate was decreased 30 percent from the base case value of 2.66E-4/hr to permutation value of 1.86E-4/hr.
- Case 3: first order photodegradation rate was decreased 30 percent from the base case value of 0.017/hr to permutation value of 0.012/hr.
- Case 4: organic carbon content was decreased 30 percent from the base case value of 0.05/0.1 to permutation value of 0.035/0.07.
- Case 5: bacterioplankton population in the water column was decreased 30 percent from the base case value of 100,000 colony forming unit(cfu)/mL to permutation value of 70,000 cfu/mL.
- Case 6: input loading increased 30 percent from the base case value of 0.063 kg/ha in the simulation year to permutation value of 0.082 kg/ha.

EXAMS modeling was conducted to simulate the surface water concentrations in the pond using the permutation value in each case. Figures P-14 to P-17 graphically present the comparison of the base case output with the output of each permutation case. The output concentrations of each permutation case at 30 days are included in Table P-26. The percent of change for these concentrations was then calculated and presented in Table P-26. In addition, relative sensitivity was ranked for each permutation parameter based on the percent of change in output.

Sensitivity analysis results indicate that input loading appears to be the most sensitive parameter for prediction of DRC-1339 concentrations in the water column and benthic sediments. A 30 percent increase in input loading of DRC-1339 yielded up to 30 percent of increase in surface water concentrations at 30 days.

Organic carbon content appears to have a significant effect on the sorbed concentrations of DRC-1339 in both water column and benthic sediments, but did not significantly affect the dissolved concentrations in both compartments. A 30 percent decrease in organic carbon content appeared to cause a decrease of nearly 30 percent in sorbed concentrations of both water column and benthic sediments.

Photodegradation rate also appears to affect the concentrations of DRC-1339 in both compartments, albeit to a lesser degree. Vapor pressure, biodegradation rate, and bacterioplankton population appear to have the least effect on the DRC-1339 concentrations in both compartments.

MINTEQA2 Sensitivity Analysis. Two sets of sensitivity analysis were conducted to evaluate changes in dissolved concentrations of ionized zinc in surface water (hypothetical pond) as a function of change in specific key parameters used for modeling with MINTEQA2. The two key parameters considered in the sensitivity analysis include water column pH and total suspended solids (TSS).

Figure P-18 presents the percent equilibrium distribution of dissolved and sorbed ionized zinc with changes in pH. The dissolved ionized zinc concentration increased from 6 percent at pH of 7 to 86 percent at pH of 6. It appears that pH concentration has a significant effect on the equilibrium distribution of dissolved and sorbed concentrations for ionized zinc.

Figure P-19 presents the percent equilibrium distribution of dissolved ionized zinc concentration (relative to sorbed concentrations) with changes in total suspended solids. Dissolved ionized zinc concentration decreased from 17.5 percent at TSS of 10 mg/L to 3.8 percent at TSS of 50 mg/L (water column pH held constant at 7). However, this concentration decreased from 95 percent at TSS of 10 mg/L to 80 percent at TSS of 50 mg/L when the water column pH was held at 6. These results suggest that both pH and TSS appear to affect the equilibrium distribution of dissolved ionized zinc within the water column, although pH asserts a stronger influence on output.

(e) Conclusions

The next section of this Appendix provides a discussion of the analysis and results by specific product. The overall risk assessment conclusions, which include a comparison of the findings of this assessment with other relevant assessments (such as USFWS Biological Opinions) and recommendations for mitigation, can be found at the end of this report (see p. P-279).

Table P-25

PRZM Sensitivity Analysis for Surface Soil Concentrations and Simulated Off-Site Transport of DRC-1339

			Surface Soil Concentrations (mg/kg) Permutation Output		
Parameters	**Base Case Value**[a]	**Permutation Value**[b]	**At Day 5**	**Percent Change**	**Rank**[c]
Base Case[a]			0.3124		
Case 1: rainfall[e]	118 cm/yr	154 cm/yr	0.3054	2.24	1
Case 2: rainfall[f]	118 cm/yr	154 cm/yr	0.2346	24.90	2
Case 3: runoff curve #	94/91/93	72/70/72	0.3137	0.42	1
Case 4: erodibility factor	0.19	0.25	0.312	0.13	1
Case 5: soil half-life	2 days	2.6 days	0.4186	33.99	3
Case 6: Koc/Kd	137/3.18	178/4.13	0.3273	4.77	1
Case 7: application rate	0.56 kg/ha	0.73 kg/ha	0.4072	30.35	3

[a] See Table P-23 for the input parameters of base case.

[b] These changes were made by a fixed percentage (30 percent) to allow comparison.

[c]
Rank	Percent Change
1	<10
2	10-31
3	30-50
4	>50

[d] Annual cumulative runoff (or erosion) of DRC-1339 (kg/ha) in the simulation year.

[e] 30 percent increased rainfall was distributed throughout the simulation year.

[f] 30 percent increased rainfall was distributed throughout the first month following application (at 1.183 Rank & Change)

Surface Soil Concentrations (mg/kg) Permutation Output

At Day 20	Percent Change	Rank[c]	Cumulative Run-off (kg/ha)	Percent Change	Rankc	Cumulative Erosion[d] (kg/ha)	Percent Change	Rank[c]
0.09564			0.06115			0.002647		
0.09412	1.59	1	0.073125	19.58	2	0.003089	16.70	2
0.04913	48.63	3	0.13128	114.69	4	0.006231	135.40	4
0.096	0.38	1	0.01275	79.15	4	0.000687	74.05	4
0.09553	0.12	1	0.06101	0.23	1	0.00329	24.29	2
0.1654	72.94	4	0.08903	45.59	3	0.003819	44.28	3
0.1004	4.98	1	0.05218	14.67	2	0.002919	10.28	2
0.1247	30.38	3	0.079715	30.36	3	0.00345	30.34	3

Table P-26

EXAMS Sensitivity Analysis for DRC-1339 Concentrations in Surface Water (at 30 days)

			Concentrations in Water Column Permutation Output							*Concentrations in Benthic Sendiments*				
Parameters	Base Case Value[a]	Permutation Value[b]	Disloved (mg\L)	% Change	Rank[c]	Sorbed (mg\kg)	% Change	Rank[c]	Pore (mg\L)	% Change	Rankc	Sorbed (mg\kg)	% Change	Rankc
Base Case			0.0219			0.15			0.00261			0.0357		
Case 1: vapor pressure	1.06E-4 torr	7.28E-5torr	0.0219	0.00	1	0.15	0.00	1	0.00261	0.00	1	0.0357	0.00	1
Case 2: biodegradation rate	2.66E-4 /hr	1.86E-4 /hr	0.0219	0.00	1	0.15	0.00	1	0.00262	0.38	1	0.0359	0.56	2
Case 3: photodegradation rate	0.017 /hr	0.012 /hr	0.0236	7.76	2	0.16	6.67	2	0.00271	3.83	1	0.0371	3.92	2
Case 4: organic carbon content	0.05/0.1	0.035/0.07	0.0222	1.37	1	0.11	26.67	3	0.00262	0.38	1	0.0251	29.69	3
Case 5: bacterioplankton pop.	1.0E+5 cfu/ml	7E+4 cfu/ml	0.0219	0.00	1	0.15	0.00	1	0.0026	0.38	1	0.0356	0.28	1
Case 6: input loading	0.063 kg/ha/yr	0.082 kg/ha/yr	0.0282	28.77	3	0.19	26.67	3	0.00339	29.89	3	0.0465	30.25	3

[a] See Table P-24 and P-25 for the input parameters of base case.

[b] These changes were made by a fixed percentage (30%) to allow comparison.

[c] Rank

Rank	% Change
1	<5
2	5 – 20
3	>20

Figure P-13A **PRZM Sensitivity Analysis of DRC-1339 for Surface Soil Concentrations**

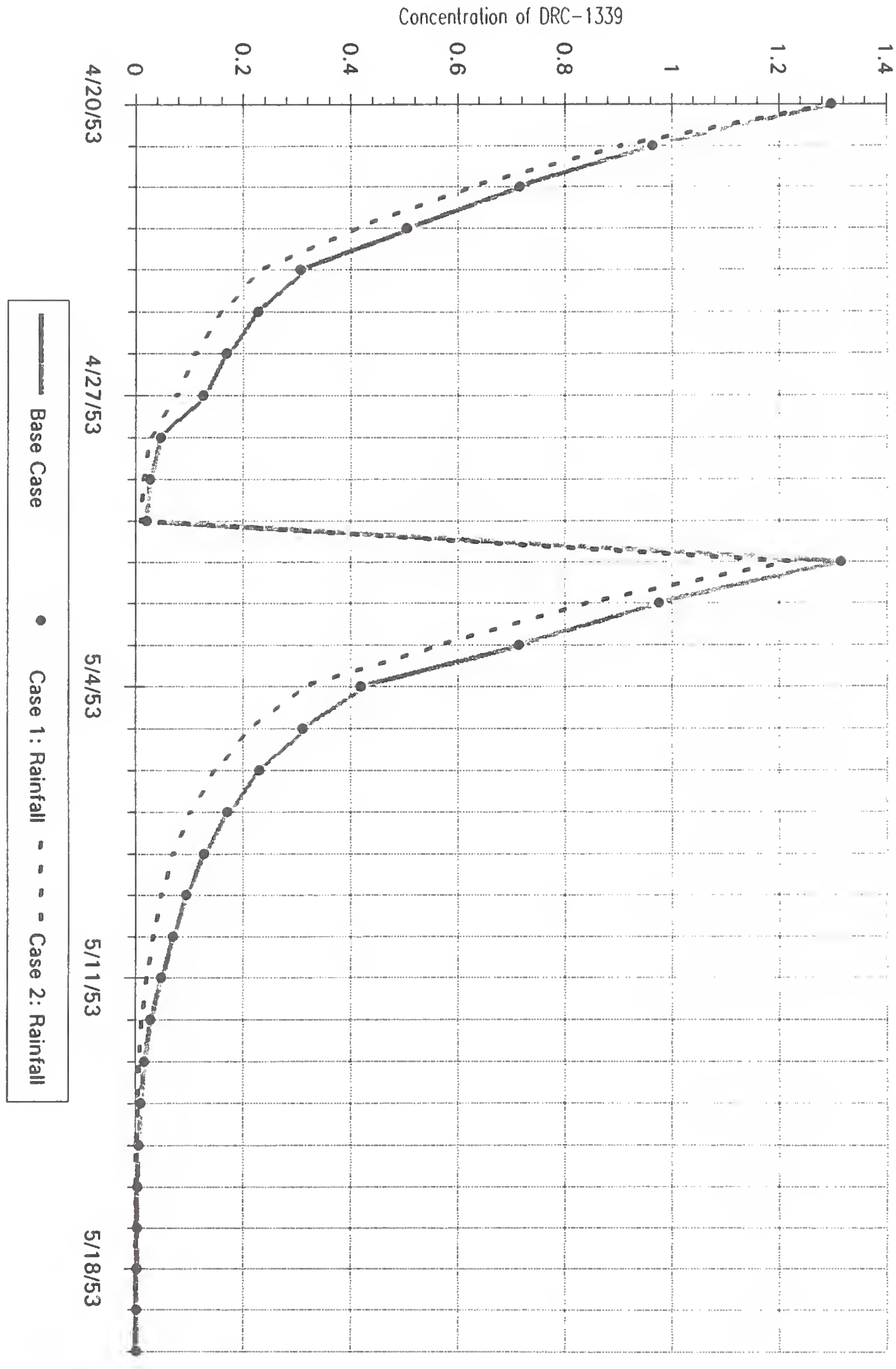


Figure P-13B **PRZM Sensitivity Analysis of DRC-1339 for Surface Concentrations**

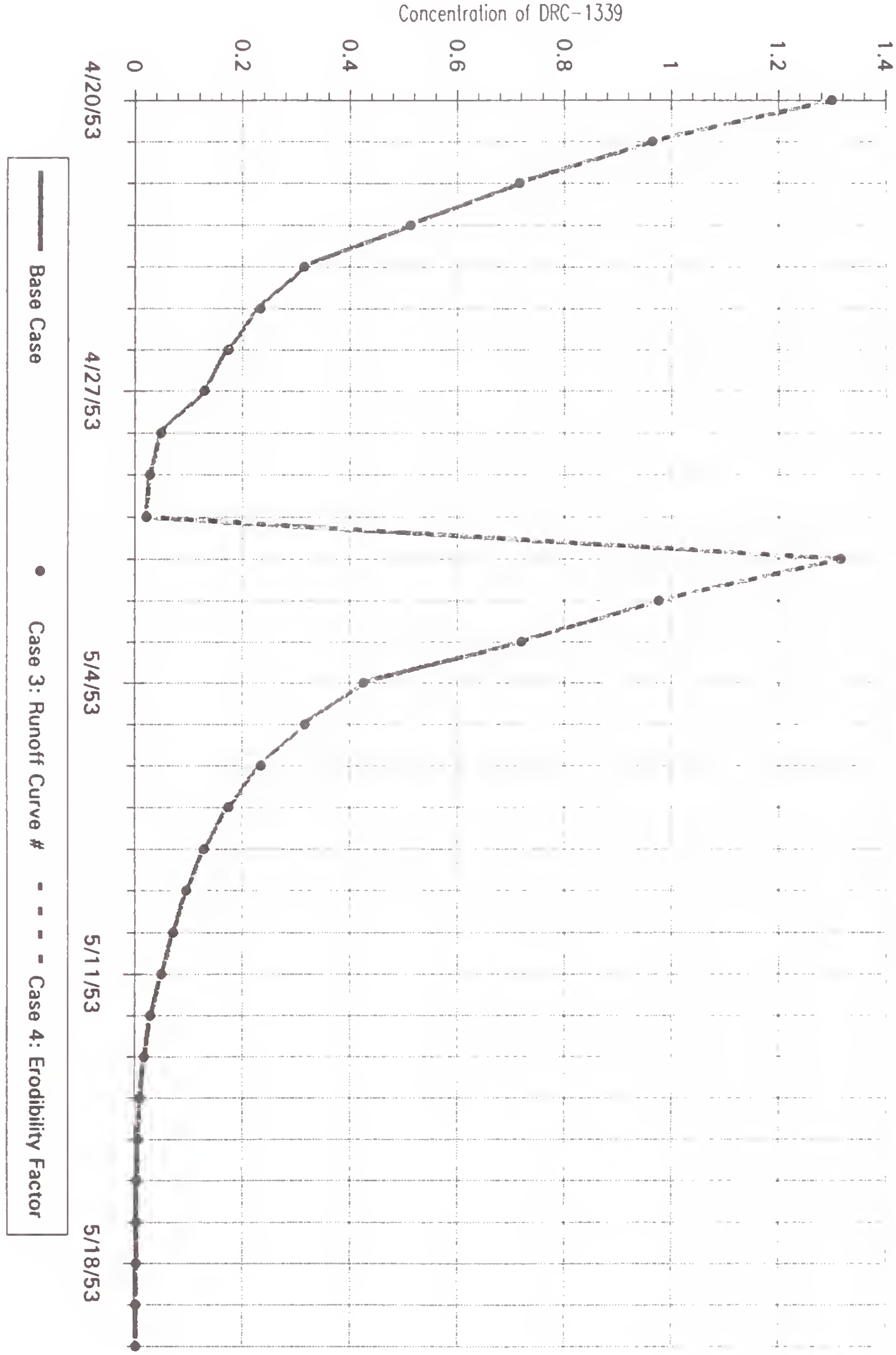


Figure P-13C **PRZM Sensitivity Analysis of DRC-1339 for Surface Soil Concentrations**

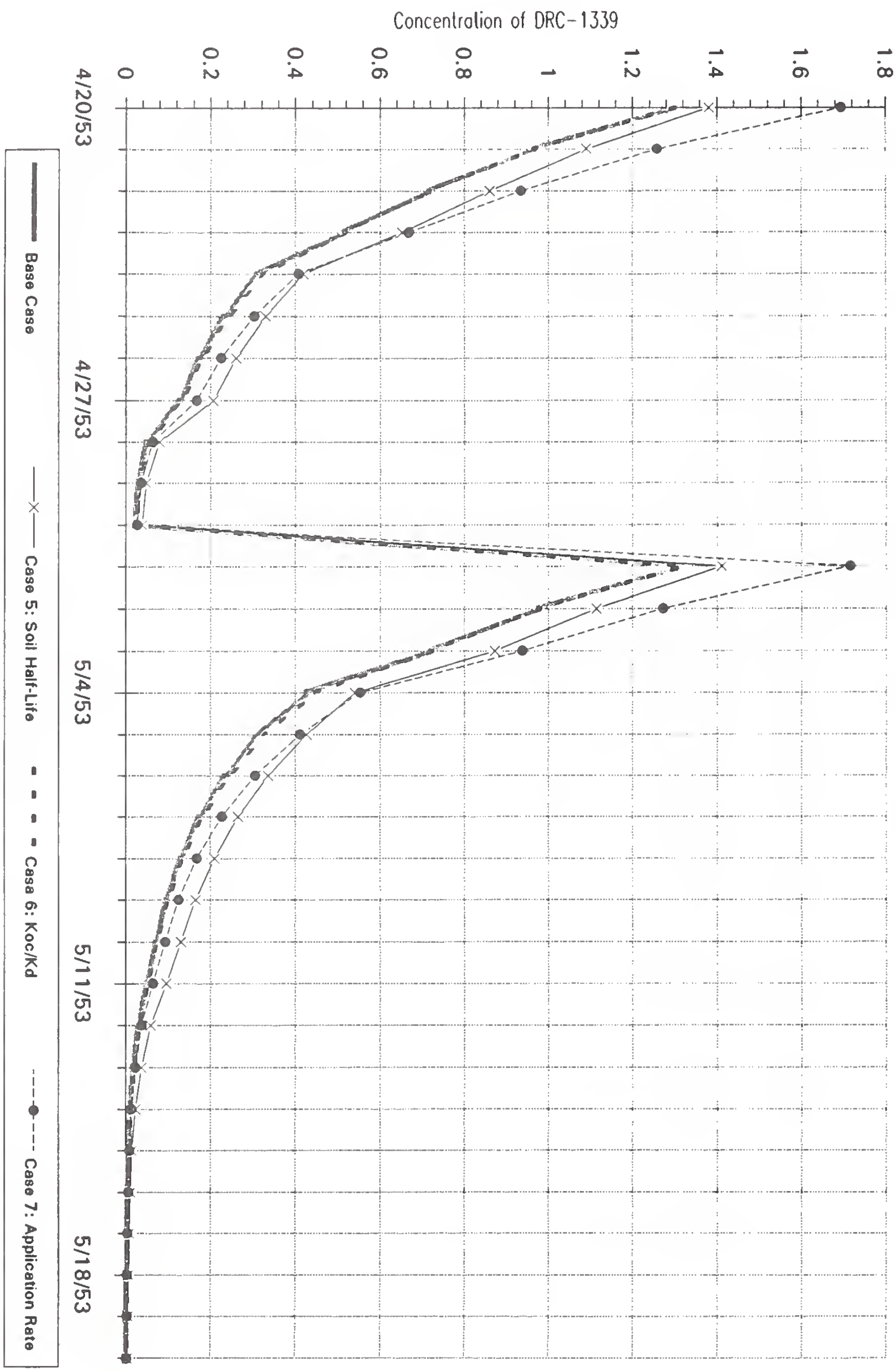


Figure P-14A **EXAMS Sensitivity Analysis of DRC-1339 Concentrations (Dissolved in Water Column) in a Hypothetical Pond**

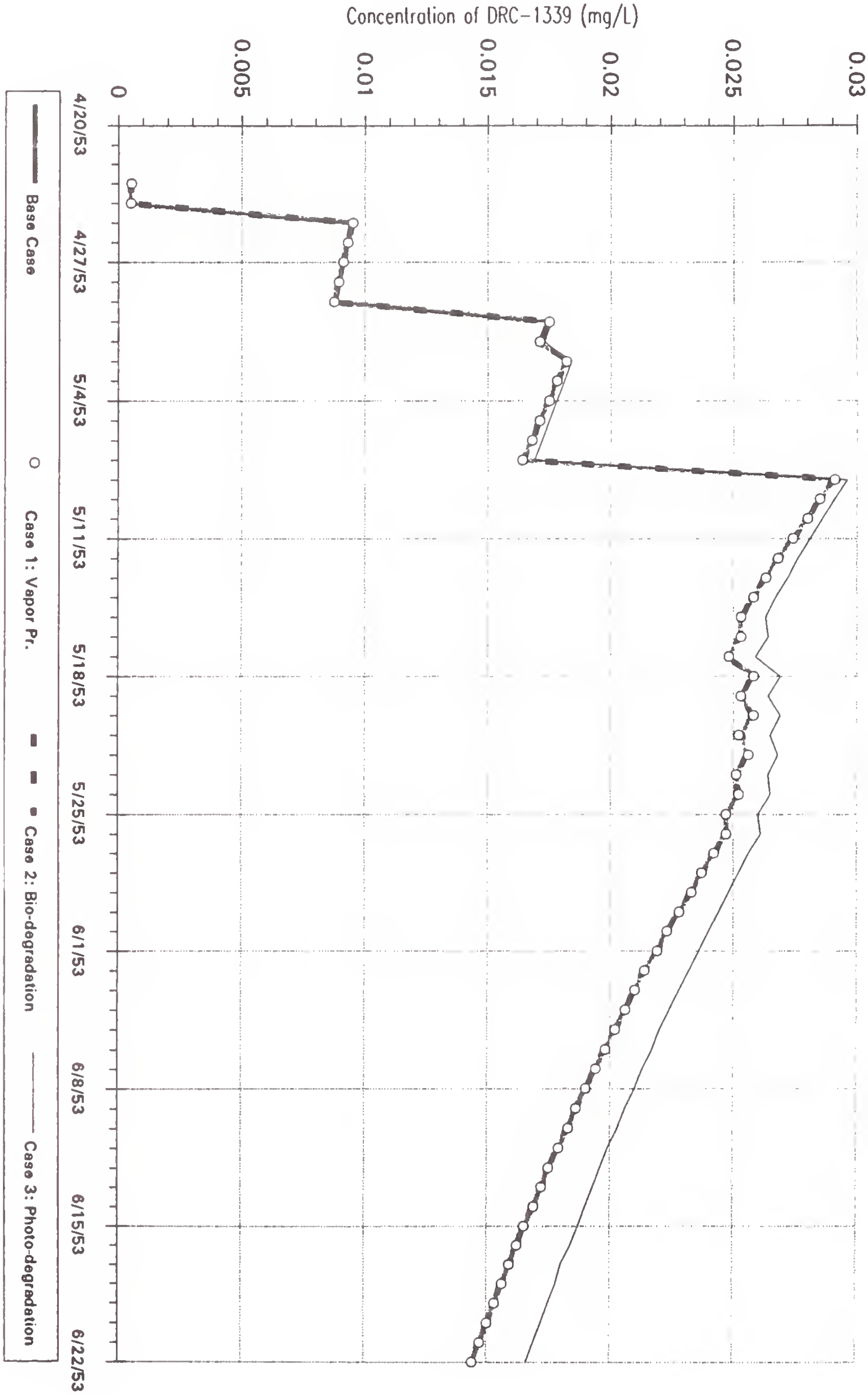


Figure P-14B **EXAMS Sensitivity Analysis of DRC-1339 Concentrations (Dissolved in Water Column) in a Hypothetical Pond**

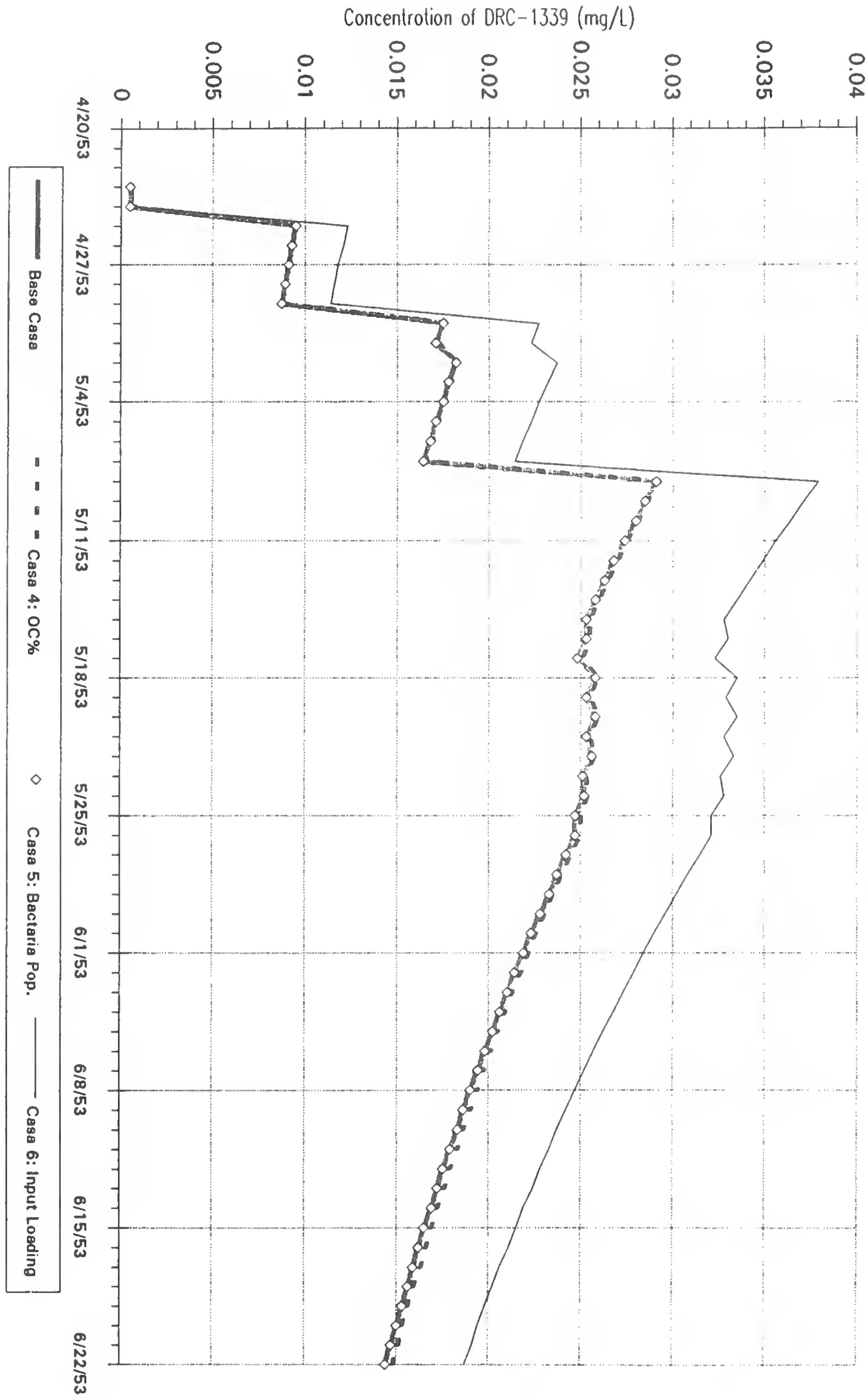


Figure P-15A **EXAMS Sensitivity Analysis of DRC-1339 Concentrations (Sorbed in Water Column) in a Hypothetical Pond**

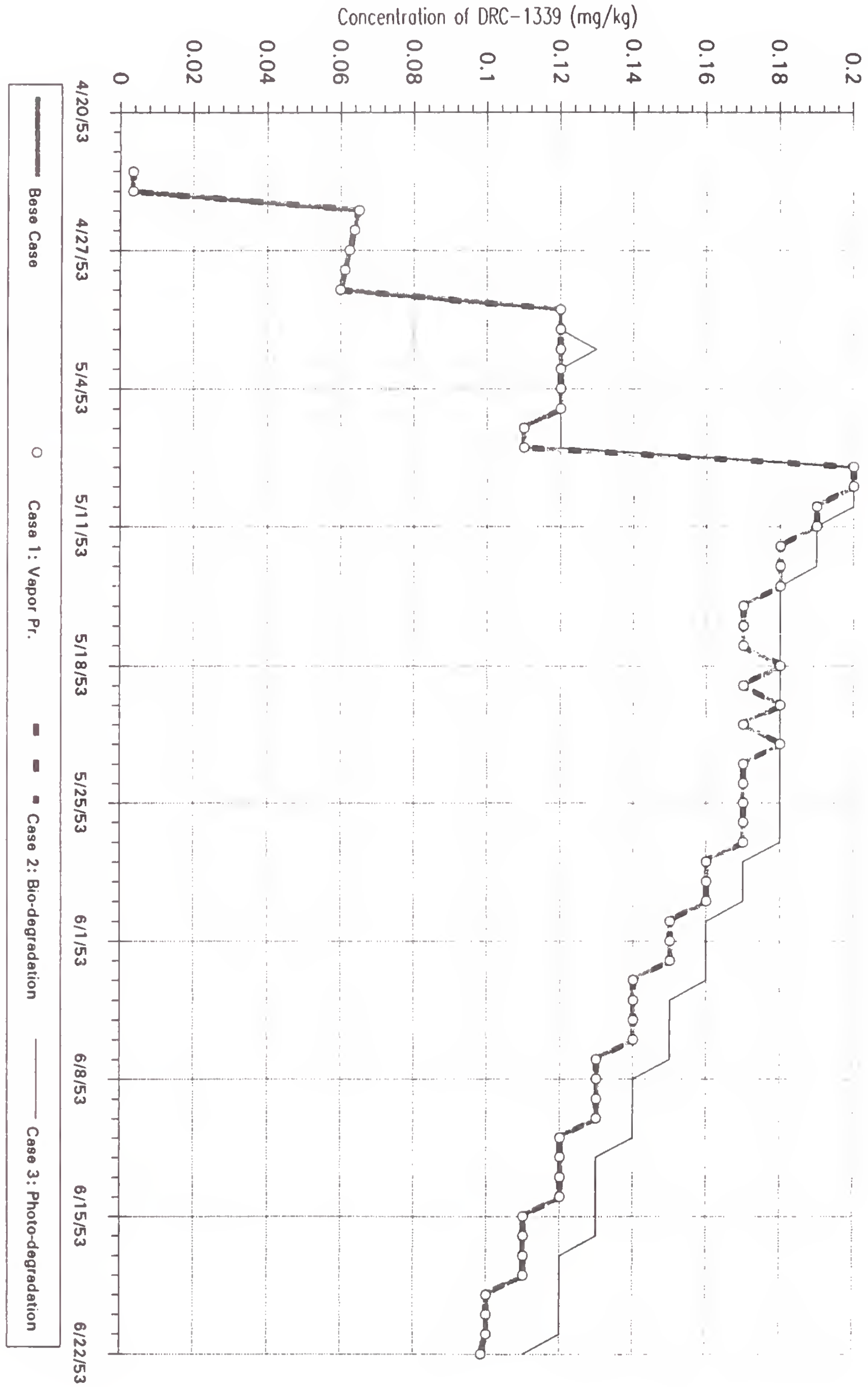


Figure P-15B **EXAMS Sensitivity Analysis of DRC-1339 Concentrations (Sorbed in Water Column) in a Hypothetical Pond**

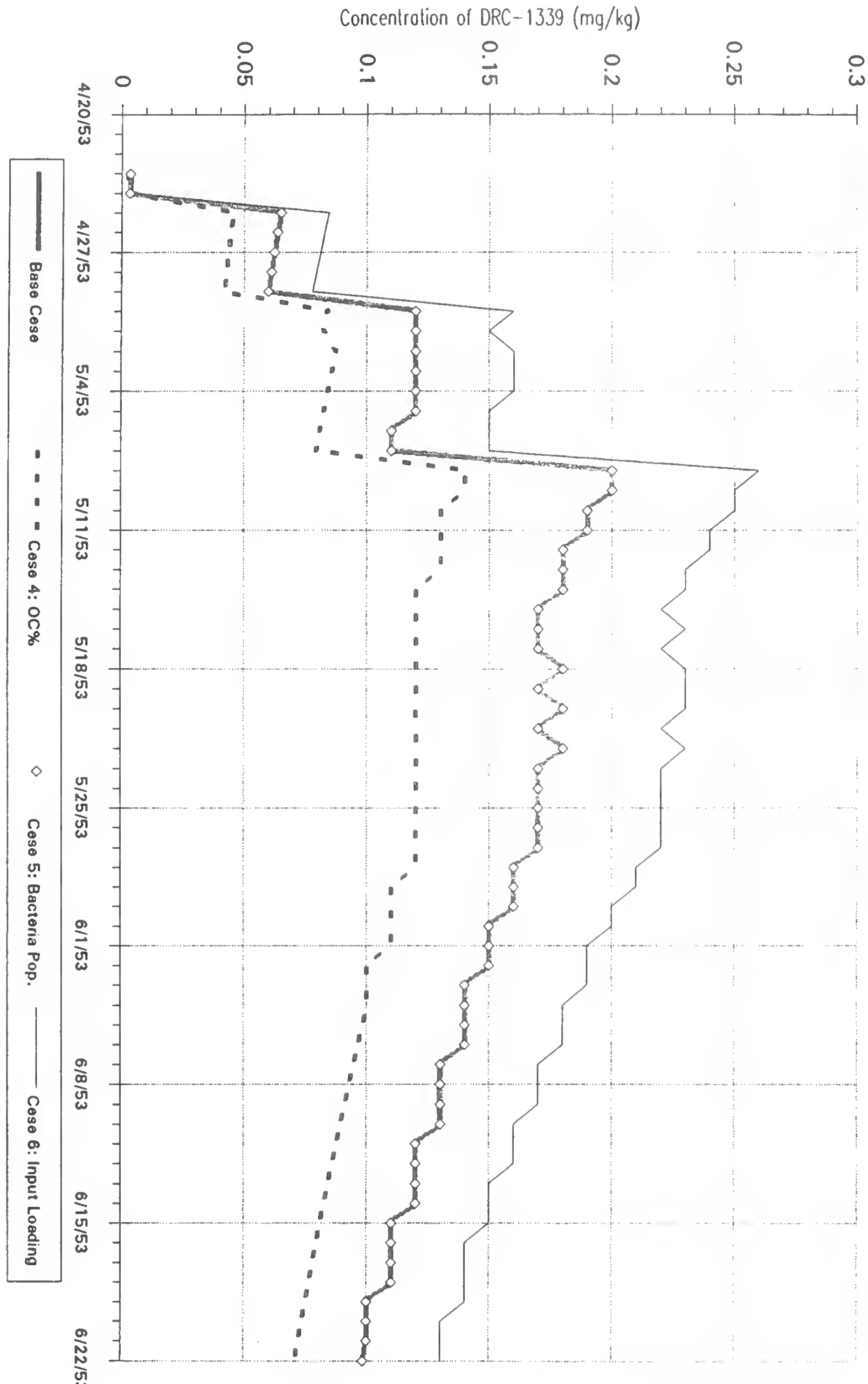


Figure P-16A **EXAMS Sensitivity Analysis of DRC-1339 Concentrations (Pore in Benthic Sediment) in a Hypothetical Pond**

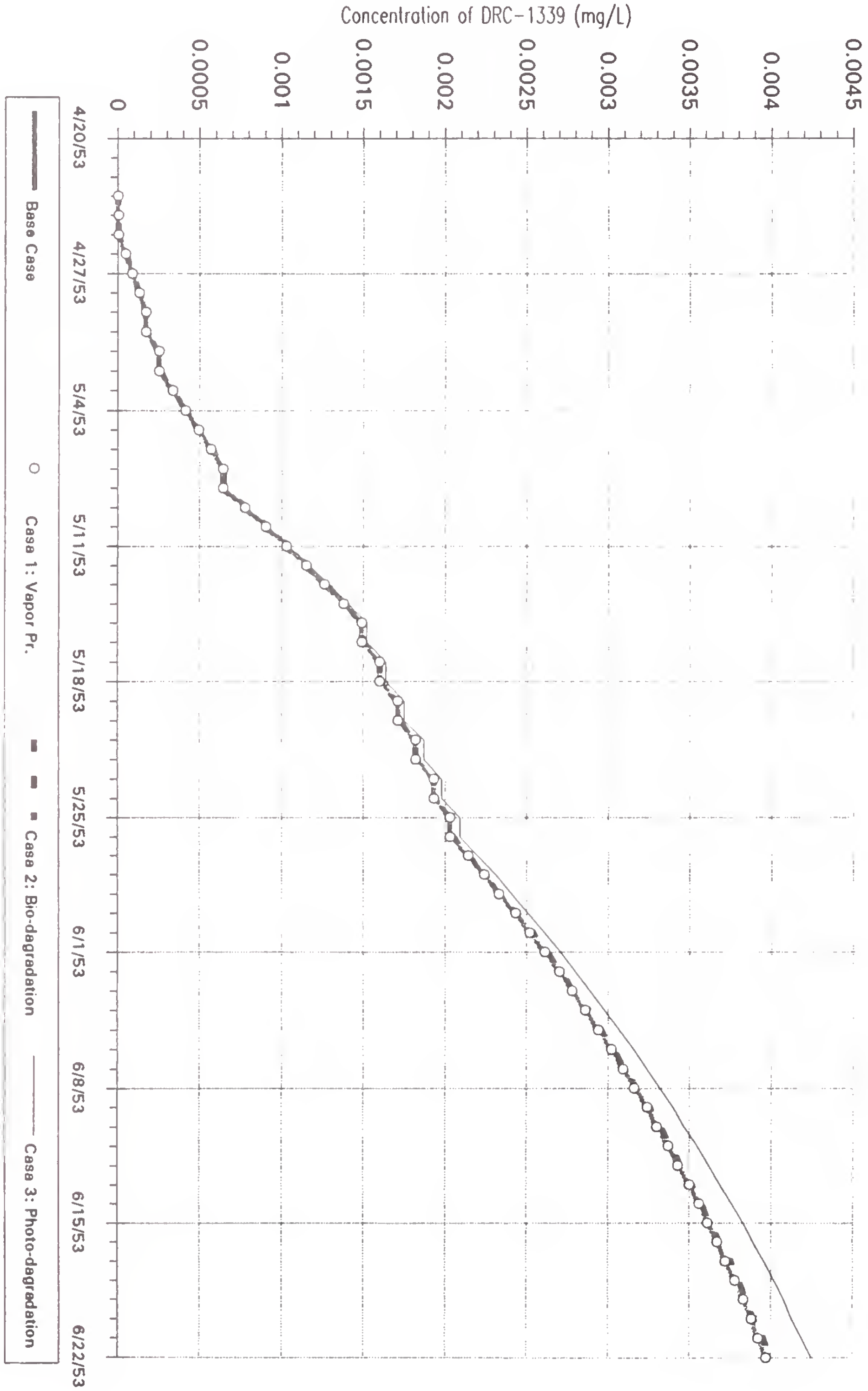


Figure P-16B **EXAMS Sensitivity Analysis of DRC-1339 Concentrations (Pore in Benthic Sediment) in a Hypothetical Pond**

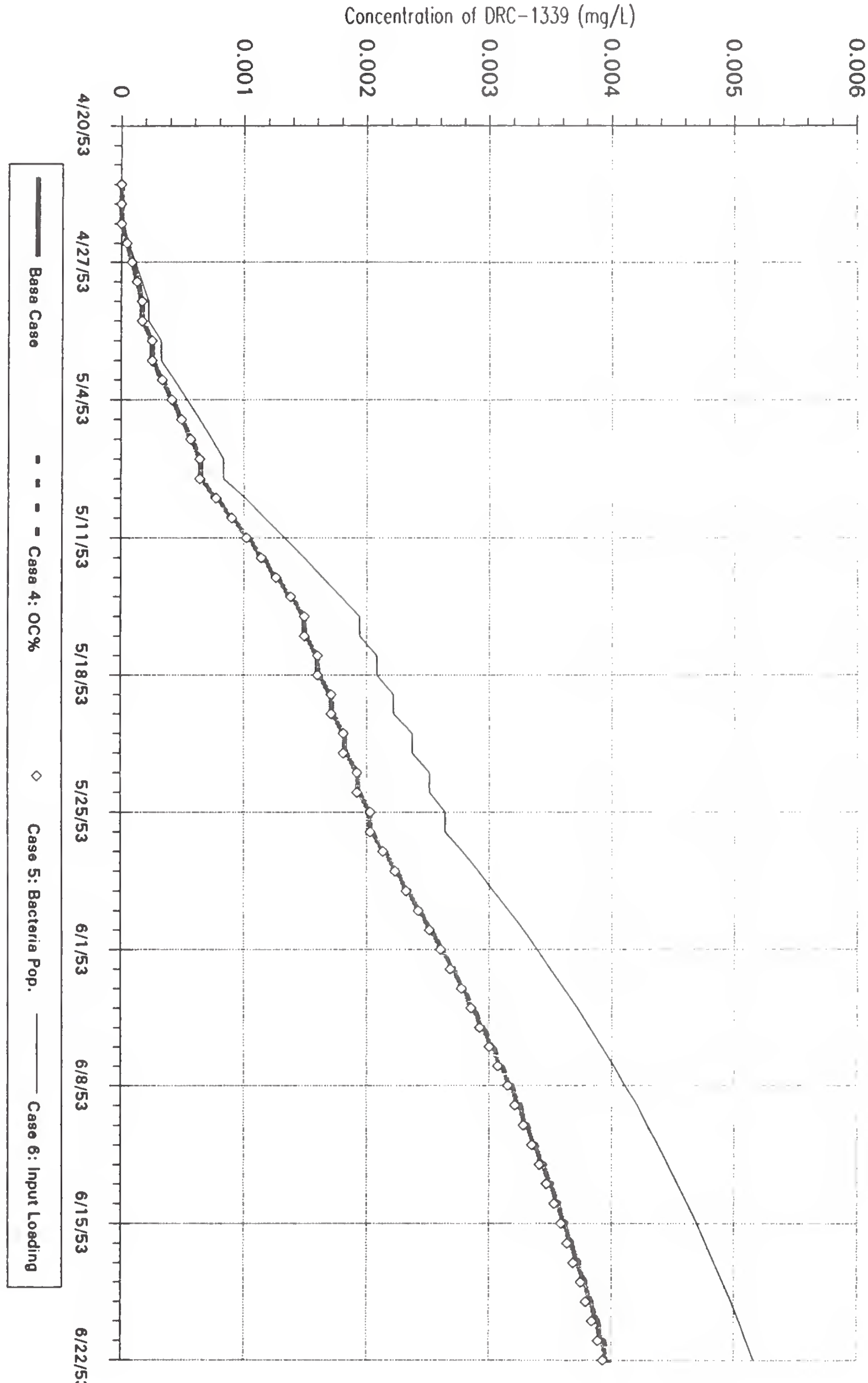


Figure P-17A **EXAMS Sensitivity Analysis of DRC-1339 Concentrations (Sediment) in a Hypothetical Pond**

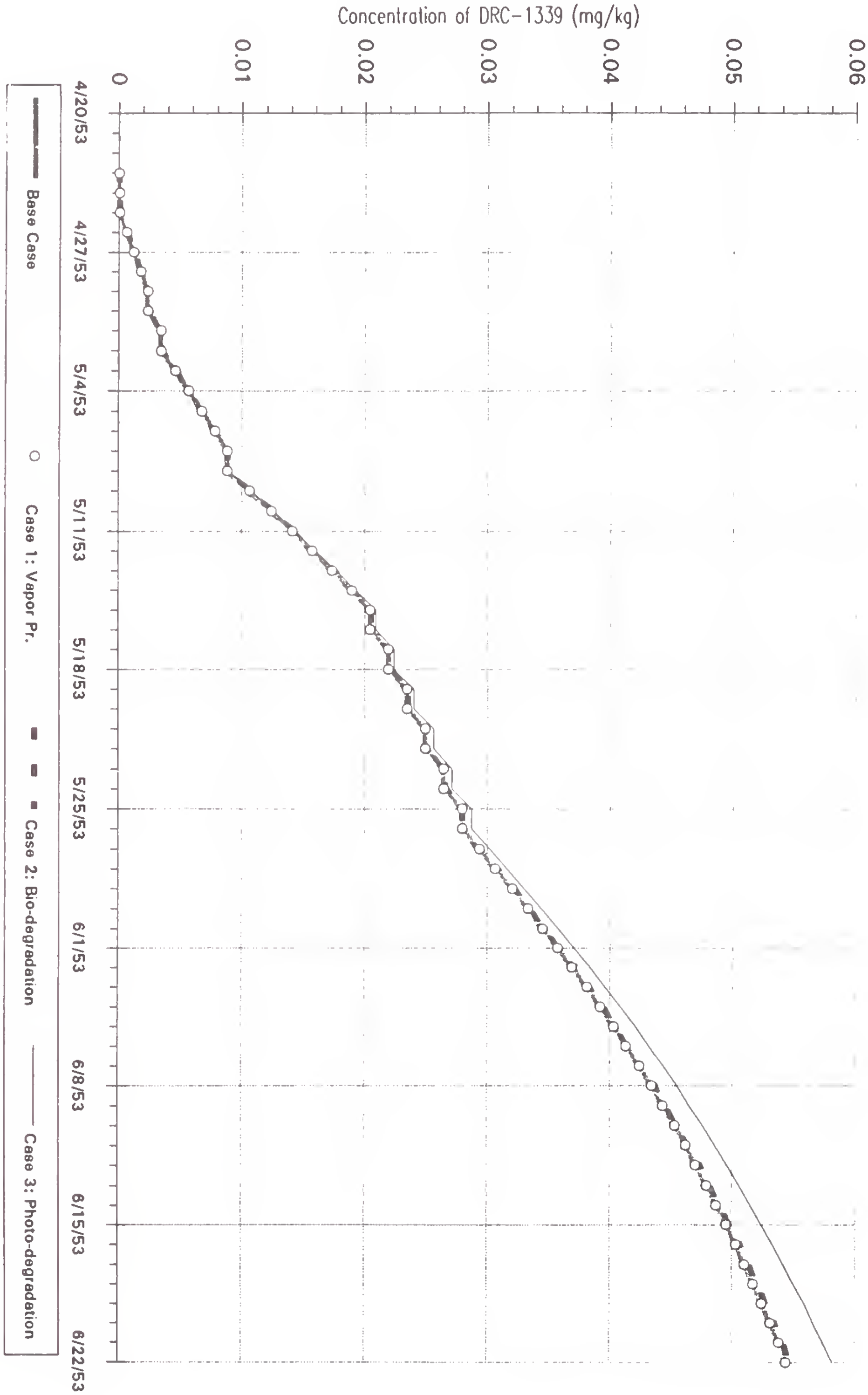


Figure P-17B **EXAMS Sensitivity Analysis of DRC-1339 Concentrations (Sediment) in a Hypothetical Pond**

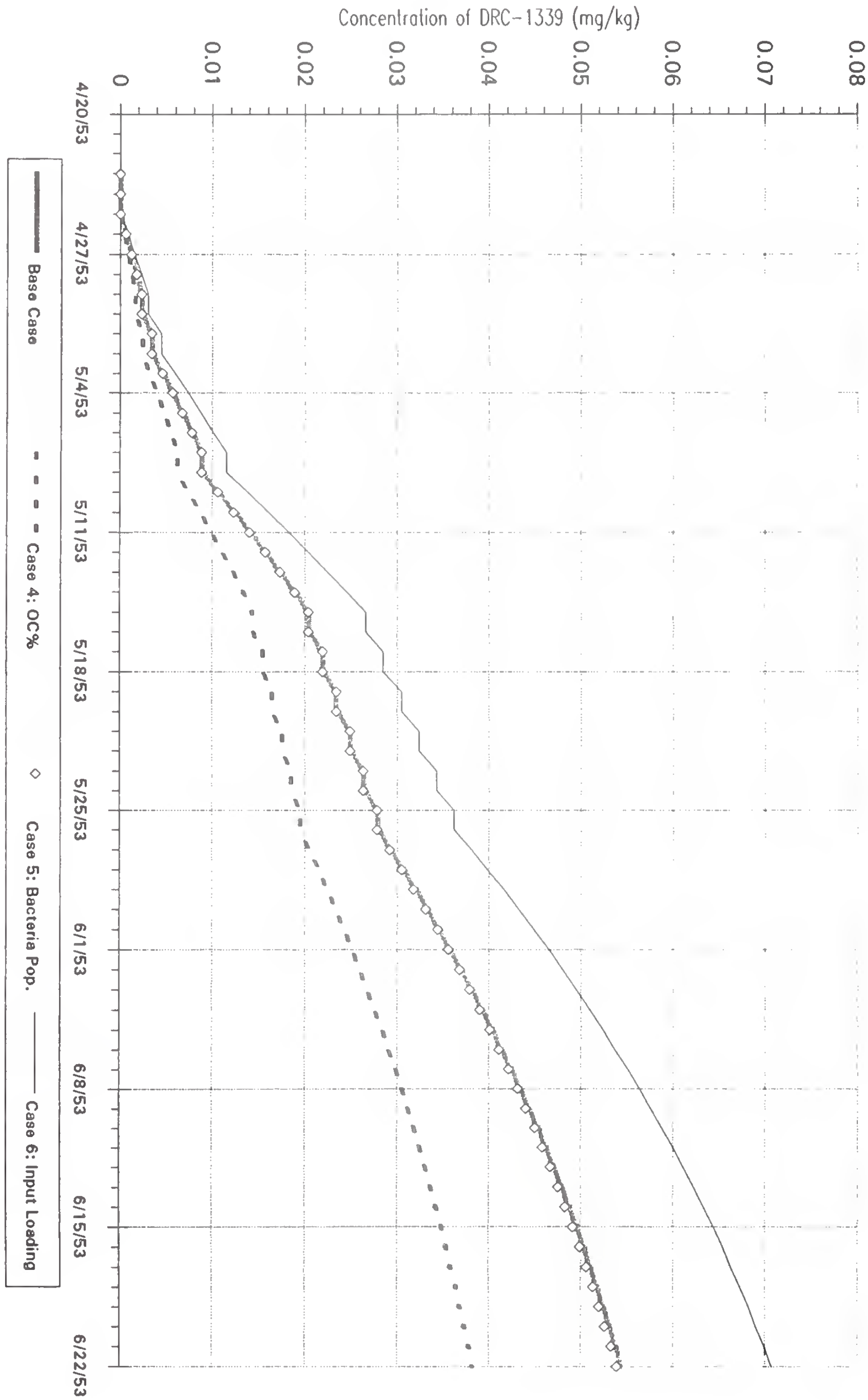


Figure P-18 **MINTEQA2 Sensitivity Analysis: Equilibrium Distribution of Ionized Zinc vs. pH**

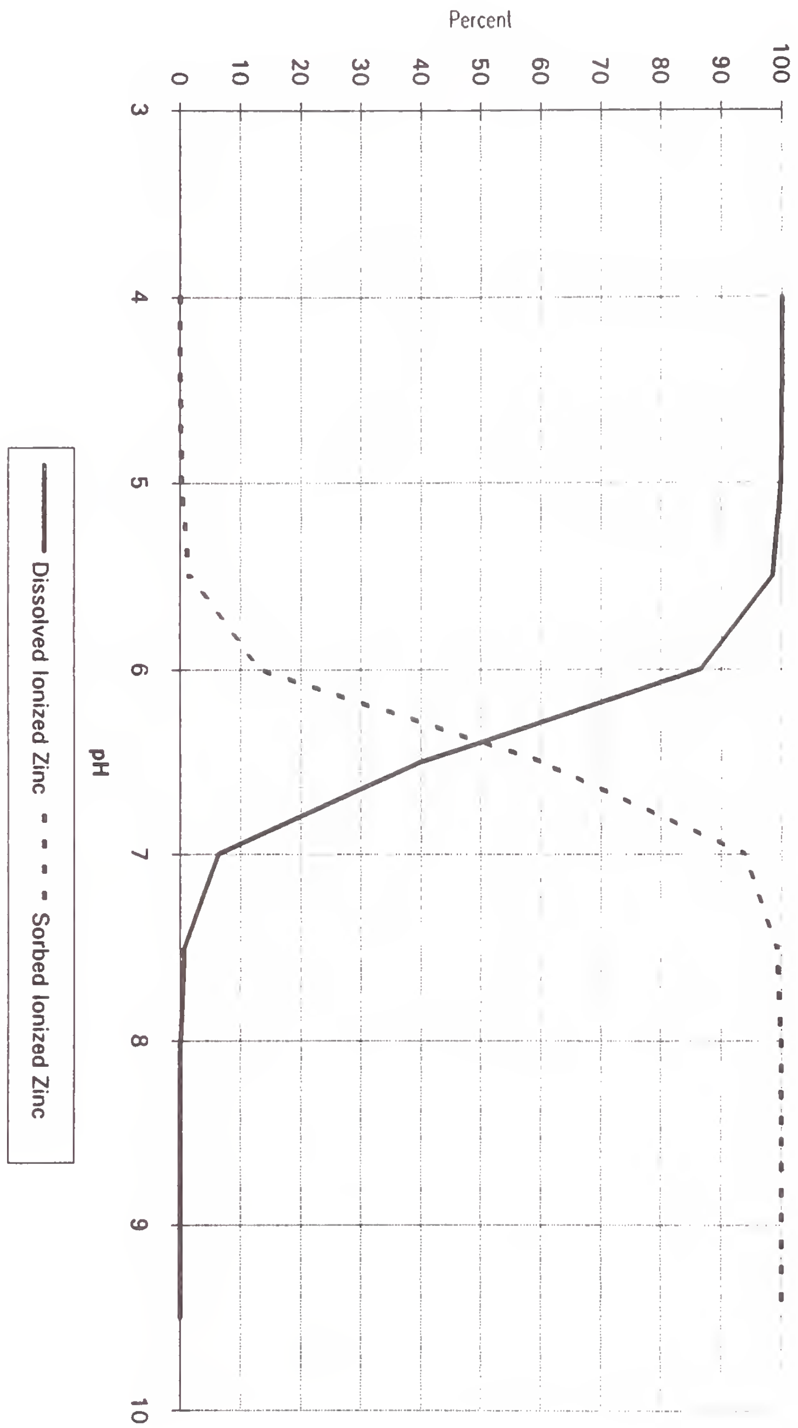
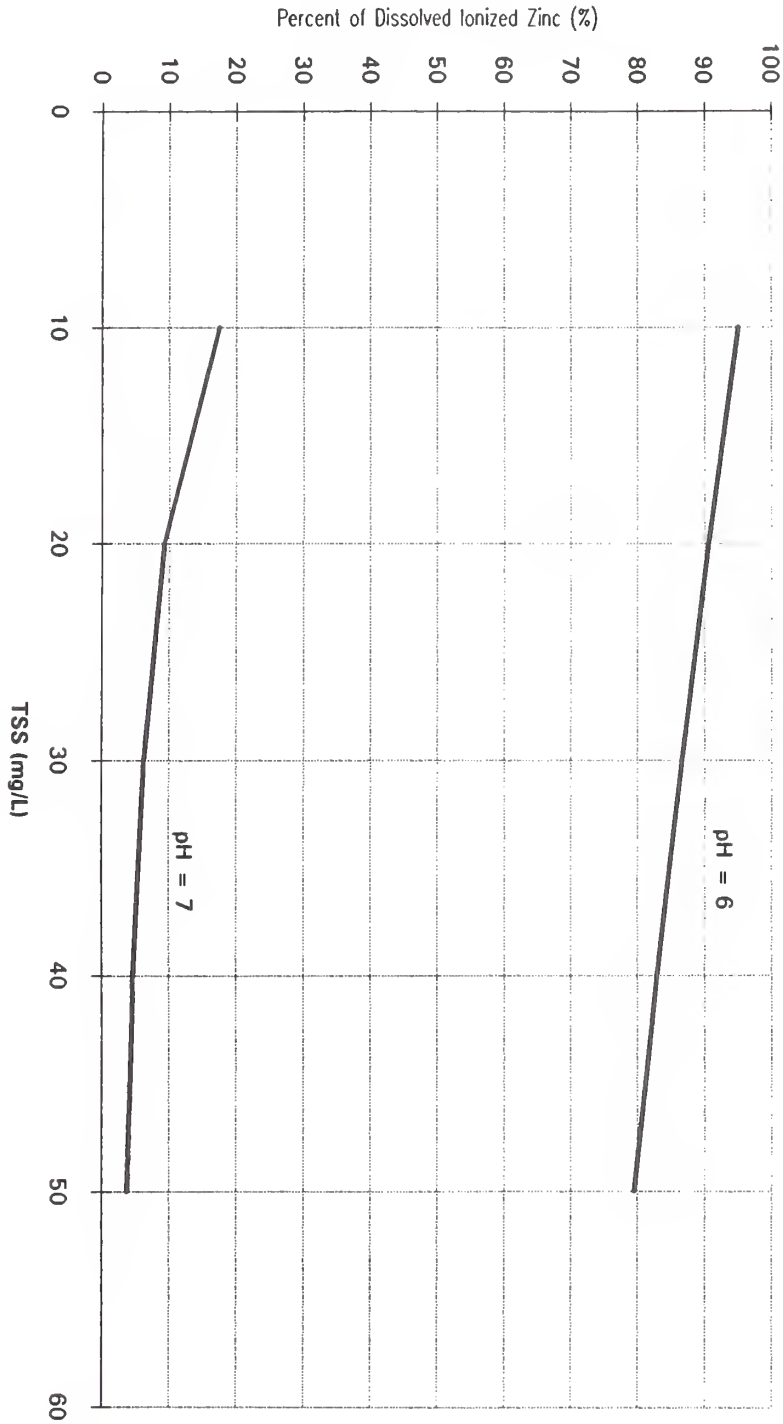


Figure P-19 **MINTEQA2 Sensitivity Analysis: Equilibrium Distribution of Ionized Zinc vs. TSS**



6. Discussion of Specific Products

a. Introduction

This section provides specific information by **compound** (active ingredient) and by **end-use formulation**, as appropriate. The intent of presenting this information is to document results obtained from each stage of analysis. The section is organized to follow the detailed presentation of the rationale and approach used to conduct the chemical methods risk assessment. For each compound or end-use formulation, the elements indicated below are included in the discussion. These elements are summarized in tabular form in Tables P-28, P-29, and P-30, which are included in the section entitled "Discussion and Conclusions," which begins on page P-279.

Discussion and results by compound (active ingredient). The discussion of active ingredient as a level of organization involves information that applies to the active ingredient, including such general use pattern information as type of agents and formulations used for chemical control (e.g., toxicant, repellent, or other formulation), mode of application, resources protected, and location, number, and description of States or regions where products are used by APHIS ADC.

Two major considerations incorporated into the discussion of each active ingredient are environmental fate and toxicology.

Environmental fate properties include evaluation of off-site transport potential. **Toxicology** includes consideration of primary, secondary, and aquatic toxicity as well as the toxicological benchmark values derived to estimate potential risk to nontarget receptors. While both of these components were vital to the overall analysis, they are insensitive to change in formulation. The basic properties of the active ingredient determine toxicity and environmental behavior, which do not change with individual formulation. It was therefore unnecessary to discuss these properties separately for each formulated product.

Discussion and results by formulated product. A discussion of key considerations relating to specific formulations follows the discussion of active ingredients, with the overall emphasis placed on findings, conclusions, and recommendations/mitigation, as appropriate, for each stage of the risk assessment. The level of effort and detail provided in this discussion is commensurate with the level of effort dictated by findings from the screening and/or risk assessment process. It is further noted that the four products subjected to the most rigorous, representative scenario level of analysis are discussed in greatest detail. Key issues detailed in the formulation-specific discussion are:

- Formulated product use pattern.
- Habitats and nontarget species of potential concern, including primary and secondary exposures, T&E species, and other potential human or ecological nontarget exposures.
- Results of screening: (1) if the product was screened out based on the critical element phase of screening, these results were documented, which then constituted the extent of overall analysis; (2) if the cumulative score was below the threshold of 35, the basis for scoring was documented; this documentation, somewhat more rigorous than critical element screening, represented the final discussion for the individual product; (3) if the cumulative score equaled or exceeded the threshold of 35, the product was carried forward to QRA.
- Results of QRA: (1) Results of the **exposure assessment** included a product-specific delineation of exposure pathways, indicator species, exposure factors, and quantification of exposure, including key assumptions and modeling procedures used; (2) **Risk characterization** included characterization of potential primary and secondary hazards (incorporating toxicological benchmark values from the earlier discussion of the a.i.), the uncertainty/sensitivity analysis, and analysis of potential effects to T&E

species; (3) **Risk assessment conclusions** were presented; and (4) conclusions were compared with findings from other parallel studies, including the USFWS and USEPA efforts. In the discussion of the results of the QRA, reference is made to the HQ values, which are presented in summarized form in Table P-27. (Calculation and interpretation of HQ values is discussed on pp. 58 and 279.)

Following the discussion by formulated product, a final section documenting overall conclusions and recommending mitigation measures is presented.

b. Alpha-chloralose — $C_8H_{11}Cl_3O_6$; CAS #15879-93-3

(1) General Discussion

Alpha-chloralose is an immobilizing agent used to capture and remove nuisance waterfowl and other birds (e.g., pigeons). It is typically used in recreational and residential areas, such as swimming pools, shoreline residential areas, golf courses, or resorts. Single bread or corn baits are fed directly to the target waterfowl, while corn baits are placed in feeding areas to capture pigeons. APHIS ADC personnel are present at the site of application during baiting to retrieve the immobilized birds. Unconsumed baits are removed from the site following each treatment.

(2) Screening

(a) Use Patterns

Alpha-chloralose was evaluated for investigational drug status through the FDA. It was used experimentally for the capture of waterfowl and pigeons in seven States (AL, CA, MI, NM, NV, OH, OK) between FY 1988 and 1991. The immobilizing agent is approved for use by APHIS ADC under an Investigational New Animal Drug Agreement (INAD). This agent is currently used for waterfowl, coots, and pigeons. The maximum amount used during any target year was 14.9 g of a.i. in New Mexico.

(b) Potentially Exposed Nontarget Species

Primary Nontarget Hazards. Alpha-chloralose is typically delivered as a well-contained product in small quantities with minimal hazard to nontarget animals. However, some moderate effects to nontarget species have been observed.

For example, despite the intent to use alpha-chloralose to capture immobilized target birds, both target and nontarget animals have been killed during field trials. Deaths of target animals from investigational field trials conducted in Ohio, Michigan, Nevada, New Mexico, and Alabama were as follows: 82 pigeons of 1,370 retrieved, 115 American coots of 739 retrieved, 72 ducks of 929 retrieved, and 31 Canada geese of 86 retrieved (Woronecki et al. 1990; Cleary et al. 1992a, b; Woronecki and Boyd 1992; Woronecki et al. 1992). Survival of retrieved birds averaged 90 percent during the experimental field trials. A total of 33 nontarget animals died during these trials, including 13 house sparrows, five American coots, four California gulls, one Bonaparte's gull, one ring-billed gull, two domestic ducks, one great-tailed grackle, one Brewer's blackbird, and five Koi goldfish (Woronecki et al. 1990, 1992).

Secondary Nontarget Hazards. The intended use of the product, removal of immobilized birds from the control area after sedation, is expected to reduce secondary nontarget hazards. In an efficacy study with caged birds, 23 of 24 sedated birds were removed from the baiting area within 69 minutes of bait consumption (Woronecki et al. 1992).

Domestic Animals. Domestic ducks and geese could be affected by use of alpha-chloralose if they co-occur with nuisance waterfowl in recreational or residential areas. However, domestic ducks and geese often are target animals.

Threatened and Endangered Species. No T&E species are expected to be adversely affected by use of this formulated product. The Aleutian canada goose and peregrine falcon are the only listed species occurring within the range of experimental use of the product. However, these species are unlikely to be exposed to alpha-chloralose as used by the APHIS ADC program.

(c) Environmental Fate

Because alpha-chloralose was eliminated from more detailed analysis based on critical element screening, environmental fate properties of this compound were not rigorously assessed. Although little information on environmental fate and transport properties appears to be available for this compound, solubility and mobility are believed moderate and environmental persistence believed to be low. Alpha-chloralose residues are unlikely to accumulate in soils between applications, in part because small quantities are applied. Bioaccumulation in plant and animal tissues is believed to be low as well.

(d) Toxicology

Alpha-chloralose is classified as a soporific, which is a central nervous system depressant that can immobilize target species at sublethal levels. This chemical is approved for use by the APHIS ADC program to immobilize waterfowl, coots, and pigeons for easy capture.

Alpha-chloralose is used in other countries as both an avian and mammalian toxicant. The compound has been shown to be slowly metabolized, with recovery occurring a few hours after administration (Schafer 1991a). The bait is in the form of bread cubes and corn bait and is produced so that one cube or a few kernels fed by hand would immobilize the target bird. The doses used for immobilization are designed to be about two to 30 times lower than the LD_{50} dose. LD_{50} values for target birds range from 42 to more than 775 mg/kg, suggesting a wide range of target species sensitivity, with doves and pigeons being less sensitive than other birds (Woronecki et al. 1990; Schafer 1991a). Mammalian data indicate higher LD_{50} values than birds (i.e., lower sensitivity; Woronecki et al. 1990). Toxicity to rats and mice is greater than to dogs and cats (dog/cat LD_{50} values exceed 100 mg/kg (Schafer 1991a).

Toxicity to aquatic organisms is unknown, according to Woronecki et al. (1990), who found that five Koi goldfish exhibited erratic behavior and died 44 hrs after bread bait application to a pond. The dose (30 mg a.i. per bait) and number of bait applications (four) were in accordance with draft label specifications, although the dose received by the goldfish is not known. In another trial, two Koi goldfish consumed treated baits and did not die (Woronecki et al. 1992). The toxicity to aquatic organisms has not been previously investigated and will not be required for registration as agreed by FDA. This is in part because the compound is not generally soluble in water and therefore should remain unavailable to aquatic organisms other than those directly ingesting treated baits. In addition, all treated baits will either be consumed by target animals or retrieved and destroyed.

Although alpha-chloralose does not appear to accumulate in bird tissues, it has been implicated in long-term liver and kidney effects following repeated administration (Schafer 1991a). While secondary risks to predatory or scavenger species are possible, they are unlikely because immobilized target birds are required to be removed immediately.

(3) Documentation of Results

Alpha-chloralose is used as an immobilizing agent, and is subject to FDA regulation as a narcotic rather than a pesticide. This tranquilizing agent was determined to have a low likelihood of causing potential nontarget hazards according to the screening process. Factors supporting the determination of this low potential included the lack of exposure to threatened and endangered species as well as nonlisted species and the low toxicity of the active ingredient. Other supporting rationale for this determination included relatively

Table P-27

Formulation-Specific Risk Assessment Hazard Quotients Showing Calculated Daily Intake for Specific Indicators as well as Toxicological Benchmarks and Exposure Pathways[a]

				Benchmark Value		Hazard Quotient (soil pathway)		Hazard Quotient (all pathways)	
Active Ingredient	Indicator Species (wildlife)	Exposure Pathway	Daily Pesticide Ingest.[b] (mg/kg-d)	Acute mg/kg	Chronic mg/kg-d	Acute mg/kg	Chronic mg/kg-d	Acute mg/kg	Chronic mg/kg-d
4-Aminopyridine (Avitrol, 0.5%)	eastern meadowlark	primary	50	0.33	0.180	<0.01	<0.01	1.53	274
	American kestrel	secondary	0.003	0.373	0.756	<0.01	<0.01	0.01	0.01
	freshwater fish	water	0.0003	0.03	0.01	NA	NA	0.01	0.01
(Avitrol 25% Concentrate)	American crow	primary	209	0.138	NA	<0.01	NA	1,509	NA
DRC-1339 (98%)									
(staging area)	northern cardinal	primary	375	0.21	0.010	<0.05	0.07	1,758	1,658
(staging area)	American kestrel	secondary	0.011	2.22	0.444	<0.01	<0.01	0.01	0.02
(egg and meat)	golden eagle	primary	0.36	2.22	0.444	<0.01	<0.01	0.16	0.80
(egg and meat)	coyote	primary	0.12	0.71	0.28	<0.01	<0.01	0.16	0.41
(structures)	House finch	primary	370	0.21	0.010	0.06	0.09	1,734	1,635
(feedlots, and starlicide)	eastern meadowlark	primary	50	0.21	0.010	0.03	0.05	234	221
(staging area)	freshwater fish	water	0.029	0.13	0.09	NA	NA	0.22	0.026
Fenthion	House finch	primary	30,690[c]	0.30	NA	NA	NA	102,300	NA
	American kestrel	secondary	0.006	0.05	0.02	NA	NA	0.11	0.28
Strychnine									
Pigeon Bait/ Bird Toxic./ Sparrow-Cracks	eastern meadowlark	primary	300	0.09	0.625	<0.01	<0.01	3,230	384
Pigeon Bait/ Bird Toxic./ Sparrow-Cracks	American kestrel	secondary	0.05	0.08	0.033	<0.01	<0.01	0.61	1.53
SRO 0.5% (above grd)	horned lark	primary	375	0.09	0.625	0.02	<0.01	4,037	480
SRO 0.5% (all uses)	American kestrel	secondary	0.034	0.08	0.033	<0.01	<0.01	0.40	1.01
SRO 0.5% (all uses)	deer mouse	primary	425	0.04	0.208	0.05	<0.01	10,338	1,632
SRO 0.5% (all uses)	coyote	secondary	0.003	0.07	0.720	<0.01	<0.01	0.04	0.01
0.35% milo	horned lark	primary	263	0.09	0.625	0.02	<0.01	2,826	336
0.35% milo	deer mouse	primary	298	0.04	0.208	0.05	<0.01	7,237	1,142
1.6% paste	deer mouse	primary	706	0.04	0.208	0.05	<0.01	17,161	2,709
1.6% paste	black tailed deer	primary	18	0.07	0.720	<0.01	<0.01	263.49	20.49
4.9% paste	deer mouse	primary	230	0.04	0.208	0.05	<0.01	5,582	881
	freshwater fish	water	4.25E-05	NA	0.08	NA	NA	NA	<0.01
Zinc Phosphide									
2% AG (all 1.8-2% baits)	ring-necked pheasant	primary	500	1.47	0.027	<0.01	<0.01	341	10,556
2% AG (all 1.8-2% baits)	deer mouse	primary	1,700	0.47	0.58	0.03	<0.01	3,643	1,671
for mouse control	deer mouse	primary	561	0.47	0.58	0.03	<0.01	1,202	551
for muskrat control	raccoon	primary	21	0.47	0.58	<0.01	<0.01	46	21
	freshwater fish	water	0.004	0.010	NA	NA	NA	0.40	NA
	freshwater fish	water	0.000	NA	0.058	NA	NA	NA	0.01
Sodium fluoroacetate									
(Compound 1080)	golden eagle	primary	0.05[d]	0.21	0.008	NA	NA	0.23	5.79
	black vulture	primary	0.22[d]	1.67	1.00	NA	NA	0.13	0.22
	red fox	primary	0.21[d]	0.037	0.012	NA	NA	5.73	17.18
	red fox	secondary	1E-03	0.037	0.012	NA	NA	0.03	0.10

[a] Values taken from Table P-17, and P-18.
[b] Calculated daily ingestion dose based on the listed parameters. Value used for acute calculations, with an additional degradation rate factor for chronic exposure dose
[c] Calculated exposure for dermal pathway only, based on 6 hour exposure, and 5 cm^2 exposed surface area. Also assumes a 50% absorption rate, similar to other organic compounds.
[d] Daily dose equal to 50 percent of the contents of one toxic collar.

low total annual use and a limited number of potential exposure pathways. The cumulative score from the screening process was 30, below the threshold value of 35. This compound therefore warrants no further analysis in the risk assessment.

Primary Toxicity: No probable risk is expected based on the cumulative score for this component and because of the lack of hazards to listed species and the low toxicity of the a.i. Use of alpha-chloralose as an immobilizing agent may result in the death of some target and nontarget animals, but no listed species are likely to be exposed in recreational or residential areas where the bait is applied.

Secondary Toxicity: No probable risk is expected because affected birds are removed from the area following bait application.

Aquatic: No probable risk is expected because of apparent low aquatic toxicity, lack of solubility in water, and use pattern.

c. 4-Aminopyridine — $C_5H_6N_2$; CAS #504-24-5

(1) General Discussion

Avitrol (4-aminopyridine or 4-AP) is a lethal frightening agent (repellent) produced by Avitrol Corporation of Tulsa, OK. While Avitrol products are effective in single doses, prebaiting is usually necessary to achieve effective bait acceptance by the target species. Avitrol is available on ready-to-use grain baits (0.5 percent a.i.) and as a concentrate (powder; 25 percent a.i.) to be formulated on bread cubes. APHIS ADC personnel use Avitrol-treated grain baits mostly as a toxicant to safeguard public health and safety and to protect property from damage caused by house sparrows, pigeons, blackbirds, and starlings. Avitrol concentrated powder is used less often and in fewer States.

Avitrol can be used only by State-certified pesticide applicators. A total of 53 APHIS ADC program employees used one or two Avitrol products in 13 States throughout the United States in direct control activities during FY 1988 through 1991 (Table P-7). Maximum annual use of the two formulations during these years totaled 1.49 pounds of active ingredient. Avitrol products were used at all times of year, but more commonly during the winter. APHIS ADC program use during 1988 through 1991 occurred on private lands in most cases.

(2) Environmental Fate

In the environment, 4-aminopyridine may exist in either of two forms, the neutral form or the conjugate acid, depending on pH. The behavior of this compound will depend on the form present and thus on environmental conditions. Neither form is expected to volatilize readily, as the Henry's Law constant for the neutral form is low, and ionic forms generally are nonvolatile. However, it may evaporate from dry surfaces, especially if present in high concentrations (HSDB 1991a). Vapor phase 4-aminopyridine should react with atmospheric hydroxyl radicals, leading to an estimated half-life in the atmosphere of approximately eight hours (HSDB 1991a).

4-aminopyridine is very water-soluble, with a solubility of 8,800 mg/L at 25°C. A relatively low estimated K_{oc} value of 33 (Lyman et al. 1990), in addition to the high water solubility, indicate that 4-aminopyridine will be highly mobile in soils and could leach to groundwater (HSDB 1991a). However, laboratory studies have demonstrated that this compound is strongly adsorbed onto soil colloids, governed partially by pH (Starr and Cunningham 1970, 1975). Therefore, a moderately low mobility was assumed for the purposes of screening.

Biodegradation of 4-aminopyridine is expected to be slow in soil and water. Studies indicate that 4-aminopyridine is expected to be very persistent, degrading slowly in both aerobic and anaerobic soil and water, with reported soil half-lives ranging from three to 22 months (HSDB 1991a; Starr and Cunningham 1970, 1975), suggesting that 4-AP may be

persistent in soils. However, under acidic conditions, 4-aminopyridine will probably be largely ionized, and the adsorption properties of ionized compounds are generally different than the adsorption properties of neutral compounds. Further, this compound may form covalent bonds with humic materials, which may serve to reduce its bioavailability in aqueous media (HSDB 1991a).

Although 4-AP may persist in soils, the low application rate and maximum application frequency (up to four times a year for pigeons) for each site will minimize accumulation in soils between applications. This compound has also been shown to be non-accumulative in tissues as well and is rapidly metabolized by many types of birds (Schafer 1991a). The estimated aquatic bioconcentration factor (BCF of 0.9) supports this information, indicating that this compound should not bioconcentrate in aquatic organisms (HSDB 1991a).

Evaluation of Off-Site Transport Potential. The 0.5 percent formulation of 4-aminopyridine is used with grain bait and applied on the ground. The compound is very soluble and could therefore be transported off-site via surface water runoff or erosion to nearby water bodies following ground application. As noted above, the low application rate and maximum application frequency for each site will minimize accumulation and the amount transported off site. Moreover, up to 87 percent of the original 4-AP was reported as lost from bait 24 hours following simulated rainfall (Davis et al. 1985). This compound may covalently bond with humic materials, thus reducing leaching potential.

Based on its high persistence and the tendency to adsorb onto soils, 4-aminopyridine could be transported off site to nearby surface water bodies via erosion and surface water runoff. This could happen especially under such conditions as heavy rainfall. Therefore, environmental fate, transport, and exposure modeling is warranted for the evaluation of off-site transport potential and for the estimation of environmental exposure concentrations in soils and water.

(3) Toxicology

4-Aminopyridine is acutely toxic to both avian and mammalian species, with LD_{50} values generally less than 10 mg/kg, ranging from 1 to 20 mg/kg. Domestic animals are also sensitive and produce LD_{50} values of 2.3 to 12 mg/kg (Schafer 1983). Little evidence of chronic toxicity, based on cumulative exposure, was apparent in a number of studies reviewed (Schafer 1970a; Schafer and Marking 1975) for both avian and mammalian species. Chronic toxicity, however, has also been documented in starlings, although other species are less sensitive (Schafer 1970a; see also Table P-11) Human data indicate that accidental poisoning may occur and have contributed to the determination of low LD_{50} values. Aquatic organisms are acutely affected at levels as low as 0.37 mg/L (Marking and Chandler 1981).

Metabolism. This compound is incompletely metabolized within the target species, and excretion appears to be the major mechanism for elimination (Schafer 1983; Savarie and Schafer 1986; Schafer 1991a). For example, a study on metabolism found that 60 percent of the compound administered intravenously appeared unchanged in the urine of dogs during a 10-hour period (Savarie and Schafer 1986). A number of studies conducted on both birds and mammals have indicated that either the rapid metabolism, excretion, or detoxification in some manner allows for the ingestion of multiple LD_{50} doses throughout the feeding period without effect (Schafer 1970a).

Primary Toxicity. Savarie and Schafer (1986) also report that relatively little is known about the mode of toxic action for 4-aminopyridine. This compound is highly toxic to both avian and mammalian species, with LD_{50} values generally less than 10 mg/kg (range of 1 to 20 mg/kg). The most sensitive avian species identified from the literature appears to be the grackle, with an estimated LD_{50} value of 1.8 mg/kg (Schafer 1983). LD_{50} values for three sensitive bird species (weavers, sparrow, and red bishop) in Africa ranged from 1.8 to 4.2 mg/kg (Shefte et al. 1982) with no evidence of chronic toxicity based on cumulative exposure, according to Schafer and Marking (1975). Reported LD_{50} values for

domestic animals range from 2.3 mg/kg for the horse and 12 mg/kg for the dog (Schafer 1983). The rat appears to be the least sensitive, with a reported LD_{50} value of 20 mg/kg. Human data indicate that accidental poisoning could occur at an estimated LD_{50} of 0.6 mg/kg.

Schafer and Marking (1975) determined that test birds that died from acute toxicity showed no evidence of chronic toxicity based on cumulative exposure during the long-term tests. Chronic toxicity was investigated for 28 to 40 days, with a dietary LC_{50} concentration of greater than 300 ppm for both the mourning dove and coturnix quail (Schafer 1983), which equates to a dose of about 35 mg/kg-d. In contrast, a subchronic gavage study on starlings for 25 days resulted in a LC_{50} of greater than 1.8 mg/kg-day, the lowest subchronic value determined for 4-aminopyridine (Schafer 1970a). Subchronic values for avian species were generally consistent with this range, with reported values of 1.8 to 17.5 mg/kg-d for the starling and domestic chicken (Schafer 1983). Nontarget hazards reported by Besser and Hanson (1985) included house sparrows only. Chronic studies using dogs and rats indicated no adverse observable effects occurring after 90 days at dose levels of 2.5 to 5 mg/kg-day, respectively (Schafer 1970a; Schafer 1983).

Secondary Toxicity. Laboratory studies with predatory and scavenging animals have repeatedly shown minimal potential for secondary poisoning, and during field use only magpies and crows appear to have been affected (Schafer 1984). However, a laboratory study by Schafer et al. (1974) showed that magpies exposed to two to 3.2 times the published LD_{50} dose in contaminated prey for 20 days were not adversely affected. Additionally, three American kestrels fed 4-AP-killed blackbirds for seven to 45 days at levels greater than their respective LD_{50} level did not appear to be adversely affected based on pathological examination (Schafer et al. 1974).

Holler and Schafer (1982) also investigated secondary toxicity to the sharp-shinned hawk and kestrel and found no apparent indication of secondary toxicity using baits of 3 percent diluted to 1:29 ratio. In the Holler study, adverse effects were apparent with 1 percent baits diluted only to a 1:9 ratio, but with a similar final concentration as the 3 percent bait (Holler and Schafer 1982). The current bait formulation of 0.5 percent diluted to 1:5 results in a similar concentration (0.1 percent a.i.) as the 3 percent and 1 percent bait tested in the Holler and Schafer studies. Secondary poisoning is possible in species that consume unassimilated 4-AP from the gut, though that is not likely based on the low concentrations used in bait.

Aquatic Toxicity. Schafer and Marking (1975) found that catfish and bluegills were increasingly sensitive to 4-aminopyridine with decreasing water temperature, but unaffected with changes in water hardness. 96-hour LC_{50} values ranged from 2.4 and 7.6 mg/L for bluegills and channel catfish, respectively. Aquatic invertebrates were more affected, with LC_{50}s for glass shrimp and crayfish at 0.37 and 2.2 mg/L, respectively (Marking and Chandler 1981).

Benchmark Value. The determination of toxicological benchmark values for birds was emphasized because of their relatively high degree of sensitivity in addition to the potential for significant off-site transport from sites of application. Benchmark values were determined for four indicator species, three bird species and a freshwater fish. No mammalian indicator was selected because of the apparent lack of mammalian nontarget receptors.

Surrogate species were selected based on the availability of toxicological information and similarity of physiology to the indicator. The benchmarks derived are listed in Table P-23. The starling was used as the surrogate for extrapolating both acute and chronic benchmarks for the eastern meadowlark. The acute starling study (Schafer 1970a) was used to represent acute exposures because it is a well-conducted study and represents one of the most sensitive species to the compound (it is therefore assumed that it provides a conservative benchmark for other avian species).

The well-documented, 25-day chronic starling study used for evaluating chronic exposure found that starlings were more sensitive than quail (Schafer 1970a). The sparrow hawk, also known as the American kestrel, did not require a surrogate species because toxicity data were available. Uncertainty factors (UFs) were applied to both acute and chronic studies for this species to account for endpoint sensitivity and quality of the data, because the sparrow hawk was the only raptor studied. Based on available data, however, this species appears to be highly sensitive compared to other species (see Table P-23).

A total (cumulative) UF of 15 was applied to provide a conservative benchmark for the meadowlark, based primarily on interspecies variability from the study by Hill et al. (1975). The resulting acute benchmark value was 0.33 mg/kg. Extrapolation from the chronic study, a more sensitive endpoint, resulted in a UF value of 10, with a benchmark value of 0.18 mg/kg-d. The benchmark value for the American crow (based on the 25 percent concentrate formulation only) was determined from an average value of the grackle and blackbird, the two most sensitive test organisms for 4-aminopyridine. An average LD_{50} value of 2.08 was extrapolated with an uncertainty factor of 15 to conservatively estimate acute exposures only, resulting in a benchmark value of 0.14 mg/kg.

The cumulative UF value for the kestrel (acute toxicity) was 15, thus yielding a final benchmark of 0.37 mg/kg. The chronic benchmark value for the kestrel was derived from a 45-day NOEL and resulted in a UF value applied at 8 to produce a benchmark value of 0.76 mg/kg-d. The surrogate for freshwater fish was the most sensitive aquatic species found, the glass shrimp, assigned a UF value of 30, which resulted in a final benchmark value of 0.012 mg/L.

d. 4-Aminopyridine (Avitrol), 0.5 percent

(1) Use Pattern

Avitrol is a lethal frightening agent used to control damage caused by sparrows, pigeons, gulls, starlings, and blackbirds. This formulation contains 0.5 percent a.i. and 99.5 percent wheat, mixed grains, corn chops, or whole corn. During FY 1988 through 1991, this method was used by 42 APHIS ADC employees in 12 States (Hawaii, Idaho, Kentucky, New Jersey, New Mexico, North Carolina, Oklahoma, Kansas, Texas, Vermont, Washington, West Virginia). The maximum annual use per State ranged from 0.018 pound (0.00088 pound a.i.) in Washington to 189 pounds (0.945 pound a.i.) in Oklahoma. The labels for this product (11649-1,-4,-6,-7) require that the dilution ratio is not less than one part product to five parts untreated bait. Prebaiting is required to determine the maximum application rate per acre, presence of bait-consuming nontargets, and to ensure bait acceptance by the target species. Avitrol was used throughout the year in the 12 States.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Avitrol is applied in ripening grain fields, including cornfields, sunflower fields, and rice fields, to control damage by blackbirds. Avitrol has also been applied at a cemetery to reduce structural damage by black-billed magpies (Guarino and Schafer 1967).

Primary Nontarget Hazards. Any granivorous bird species associated with blackbird flocks that use ripening fields where the bait is applied could be affected by use of this formulated product. Documented nontarget kills include two mourning doves, two eastern meadowlarks, one savannah sparrow, and one house sparrow in Louisiana rice fields (Mott et al. 1982) and 24 mourning doves in sunflower fields in North Dakota (Besser et al. 1984). Other potential nontarget receptors that were observed in baited fields but apparently were unaffected included the American robin, brown thrasher, European starling, house finch, ring-necked pheasant, and song sparrow (Guarino and Schafer 1967, Besser

and Hanson 1985). Small mammals, particularly rodents, are additional potential nontarget receptors, although no dead or dying rodents have been observed in conjunction with application of Avitrol (Schafer 1984).

Secondary Nontarget Hazards. Toxicity data indicate that secondary poisoning of avian or mammalian predators or scavengers should not occur (Holler and Schafer 1982). The formulated product is readily metabolized so that even a multiple LD_{50} dose is not toxic to a predator or scavenger (Schafer et al. 1974). However, because of the rapid lethal effects of Avitrol, some hazards may occur from predators consuming unabsorbed chemical in the gastrointestinal tract of affected or dead birds (Schafer 1991a). Only one species, the American kestrel, has been documented to be affected by secondary poisoning; two of 45 kestrels were killed after consuming Avitrol-poisoned blackbirds during a lab study (Holler and Schafer 1982). Other species tested for secondary hazards that showed no adverse symptoms of intoxication included the domestic dog, black-billed magpie, red-tailed hawk, sharp-shinned hawk, and rats (Schafer et al. 1974).

Domestic Animals. The domestic dog and cat may be affected by secondary toxicity, particularly if they consume unassimilated Avitrol from the gastrointestinal tract of poisoned prey. However, when dogs were fed Avitrol-poisoned blackbirds in a lab study, no symptoms of intoxication or internal pathological changes were observed (Schafer et al. 1974).

Threatened and Endangered Species. Three listed species, the Aleutian Canada goose, the Attwater's greater prairie chicken, and the whooping crane, occur within the range of use of this formulated product and potentially would be affected by consumption of grain bait placed in ripening fields. Three additional listed species, the bald eagle, northern aplomado falcon, and peregrine falcon, could be affected by secondary toxicity from consuming prey poisoned by 4-aminopyridine. Use of 4-aminopyridine is not specifically restricted within the range of these six species.

(3) Screening

The cumulative score for the 0.5 percent formulation of 4-aminopyridine was 59, indicating that QRA would be warranted for this product. Key factors supporting this designation were: (1) potential nontarget hazards to threatened and endangered species; (2) known acute and chronic toxicity to mammalian, avian, and aquatic species; and (3) environmental fate properties showing high persistence, especially in soils. Use pattern characteristics were relatively insignificant and did not materially affect the screening outcome.

(4) Exposure Assessment

(a) Indicator Species and Exposure Factors

The eastern meadowlark was selected as the indicator species to address primary exposure to this product. This species was selected based on year-round occurrence, diet (consisting primarily of scattered grains and seeds during fall and winter), and occurrence in open cropland where the pesticide is applied. These factors could all increase the likelihood of exposure of meadowlarks to 4-aminopyridine. Potential exposure of this species is also supported by empirical observations. For example, two eastern meadowlarks, in addition to several other passerines, were reported killed following application of 4-aminopyridine in Louisiana rice fields (Mott et al. 1982).

The American kestrel is the most appropriate indicator species for secondary exposure to 4-aminopyridine. No other raptor was considered to be more exposed based on the species' diet, habitat, home range, and toxicological sensitivity. The diet of the kestrel includes up to 17 percent small birds by biomass (Smith et al. 1972; Balgooyen 1976). The kestrel inhabits open grasslands and agricultural areas where 4-aminopyridine is applied. No empirical observations of affected kestrels have been reported, but toxicological studies indicate that 4-aminopyridine may pose a potential secondary hazard to kestrels and possibly other raptors (Holler and Schafer 1982).

Exposure Factors. The eastern meadowlark was assumed to be exposed through primary ingestion of bait, with an ingestion rate assumed to be 10 percent of body weight (10.5 g/d) (Kenaga 1973). The percent of grain eaten in the diet was estimated to average 50 percent for the year, but could be as high as 100 percent for potential acute exposures. The home range is very small (about three acres; Brown 1985). The meadowlark is likely to feed over the entire range of application.

The exposure factors derived for the American kestrel were based on the ingestion of prey killed with the avicide. The kestrel ingests approximately 5 percent of its body weight based on the correlation drawn by Kenaga (1973). No other, more specifically documented ingestion rates are available for this indicator. The total ingestion rate includes 16 percent birds and 50 percent carrion (Balgooyen 1976). The amount of carrion eaten is the factor used for determining pesticide intake for secondary exposures. The home range of the kestrel is large (about 275 acres), and it was assumed to be present within this range 7 percent of the time based on an average 20-acre application area.

(b) Quantification of Exposure

Key Assumptions and Modeling Procedures. This end-use formulation has been designated as requiring a QRA with significant off-site transport potential, which may also impact several T&E species (see Table P-9). This formulation was applied in 12 States between FY 1988 through 1991. Oklahoma was selected for the PRZM modeling because the average annual rainfall in southeast Oklahoma (MLRA: code P-133B) is relatively high, ranging from 103 to 135 cm (USDA 1981). Furthermore, the maximum annual use of Avitrol 0.5 percent grain bait in Oklahoma is the highest among these 12 States. An application rate of 0.18 pounds/acre (0.5 percent a.i.) with an application frequency of once/yr were used in the PRZM modeling. The date of application was assumed to occur on April 20, 1953.

Chemical properties used for PRZM included water solubility, soil half-life, soil adsorption coefficient K_{oc}, and vapor pressure. These and other key properties are presented in Table P-19.

MLRA: code P-133B (Table P-19) covers the southeastern portion of Oklahoma and was therefore selected for the exposure assessment. Most of the soils in this area are moderately coarse textured to fine textured subsoil. "Desha" soil, classified as a silt-loam soil, is recommended by PIC/PRZM because of high runoff potential and therefore was used as part of the simulations. It was assumed that Avitrol is applied on the bare ground (no crops are incorporated into the PRZM simulation). All hydrologic properties were estimated using the PIC/PRZM program (see Table P-19).

Soil properties, such as bulk density, field capacity, wilting point, and organic carbon content, were estimated using the PIC/PRZM program.

Although Avitrol can exist in neutral form and/or the conjugated acid in the environment, only the neutral form was considered in the EXAMS modeling due to lack of information on the conjugated acid form. Furthermore, no daughter compounds of Avitrol were considered in EXAMS modeling. The major degradation processes considered by the EXAMS model include biodegradation and photooxidation. Since few data regarding hydrolysis and water photolysis of Avitrol were found, the degradation rates from these two processes were assumed to be zero. Key parameters of 4-aminopyridine considered in the EXAMS modeling are provided in Table P-21.

(c) Results for the Quantitative Exposure Assessment

The results of the simulated short-term (21 day) and longer-term (90 day) concentrations of Avitrol in surface soil (upper 2 cm) are presented in Figures P-4 and P-5. Figure P-4 also shows the run-off and erosion of Avitrol following each rainstorm. These results indicate that major declines of Avitrol concentrations in surface soil occurred in conjunction with major rainstorms. The highest surface soil concentration of Avitrol was 0.003 mg/kg, which occurred on the day of application (April 20, 1953). This concentration

remained at nearly the same level without apparent decline until a rainstorm occurred on the fourth day following application (April 23, 1953). Since several major rainstorms occurred immediately after application, surface soil concentrations dropped three orders of magnitude within 4 weeks after application (Figure P-5).

The estimated dissolved and sorbed concentrations of Avitrol in the water column and benthic compartments within the hypothetical pond are shown in Figure P-6. Concentrations in the water column increased during the first 10 days (April 20 to April 30) after field application in conjunction with rainstorms, because a significant amount of Avitrol residues were transported from the surface soil to the pond by these rainstorms during the first 10 days. The highest concentrations in the water column occurred on April 30, consisting of 0.00029 mg/L (dissolved phase) and 0.00048 mg/kg (sorbed phase). Following this increase, although there were still Avitrol residues entering the pond, water column concentrations declined because degradation began to predominate. The decline of Avitrol concentrations in the pond during the first month was relatively rapid, with another phase of moderately rapid dissipation continuing for 2 months (May 20 to July 20). A third phase of slow dissipation followed.

The Avitrol concentrations in benthic sediment started at zero (no direct loading to the benthic sediment), and increased with time until mid-June. The highest concentrations of Avitrol in benthic sediments occurred in mid-June, with 0.000025 mg/L in pore water and 0.000083 mg/kg in sediment. Results indicated that the predominant concentrations of Avitrol residues remained in the water column instead of benthic sediment.

Results presented in Figure P-6 show that the dissolved and sorbed concentrations of Avitrol in the water column are of the same shape. This reflects the partitioning of Avitrol concentrations between the sorbed and dissolved phases, which is the same phenomenon observed in the benthic sediment.

(5) Risk Characterization

Primary. Results for the eastern meadowlark suggest the potential for acutely toxic exposures based on ingestion of grain bait, supported by an acute Hazard Quotient (HQ) value of 1.5. Results also indicate potential toxic chronic exposures to grain bait, supported by a Hazard Quotient of 274. These slightly elevated values were based primarily on: (1) high orders of both acute and chronic toxicity to nontarget organisms; (2) "repellency factor" of one percent for acute exposures only; and (3) high concentrations in bait (1,000 mg/kg) at the time of application, which are not expected to attenuate due to the high persistence of the a.i.

Exposure factors supporting these calculations were designed to be conservative and also contributed to the HQ values. For example, the limited home range (approximately 3 acres) assumes 100 percent exposure at all times. These calculations also assume that the entire daily ingestion rate (10.5 g/day) occurred at the application site and consisted exclusively of treated grain.

The soil pathway was also considered for primary exposures, assuming that incidental ingestion of contaminated soil occurs while ingesting bait. The percent of incidental ingestion for all organisms was assumed to be five percent of the overall ingestion rate. The soil concentrations were calculated using PRZM modeling, with calculated values listed in Table P-9. The contribution from the soil pathway is relatively insignificant for 4-aminopyridine to both receptors, as indicated by HQ values of less than 0.01.

As noted below for other compounds, there is generally a much greater difference between acute and chronic HQ values than is observed with 4-aminopyridine. This is accounted for in part by the persistence of the active ingredient and the very rapid mode of action for this lethal repellent, which justifies the use of the repellency factor (Table P-9). In addition, no large difference is believed to exist between acute and chronic susceptibility to the compound.

Results of the quantitative risk assessment suggest that potential hazards could exist for any birds consuming 4-aminopyridine treated grain bait, due in part to broad spectrum avian toxicity. Hazards are highest to granivorous bird species feeding in ripening fields where the bait is applied. Nontarget hazards have been specifically reported for meadowlarks, mourning doves, and sparrows.

Primary hazards potentially exist for three listed species occurring within the range of use of this formulated product, consisting of the Aleutian Canada goose, the Attwater's greater prairie chicken, and the whooping crane. The Aleutian canada goose occurs along the southern Washington coast during spring and fall migration and could be adversely affected by consumption of bait if the formulated product is applied within its limited range during spring or fall. The Attwater's greater prairie chicken is a year-round resident in southeast Texas, where it inhabits cultivated and uncultivated fields and forages on grains during fall and winter. This species could also be adversely affected by consumption of grain bait if the Avitrol-treated grain is applied within its limited range in during fall or winter. The whooping crane winters in New Mexico and Texas and migrates through Idaho, Kansas, and Oklahoma. This species is known to occur in croplands and forage on grains. The whooping crane could be adversely affected by consumption of bait applied within its wintering or migratory range.

Secondary Toxicity. Results of the secondary exposure analysis for the American kestrel suggest that there is little potential hazard based on its consumption of contaminated avian species, with an HQ of 0.01. The maximum estimated tissue concentration (4.9 mg/kg) was based on the LD_{50} of the starling, representing the highest projected body burden among all target species. Results also indicate that chronic toxicity constitutes even less cause for concern than acute, with an HQ value of less than 0.01.

Results of the quantitative risk assessment indicate that there is little potential hazard to raptors consuming 4-aminopyridine-poisoned prey or contaminated soil. The three listed species of raptors occurring within the range of use of this compound (bald eagle, peregrine falcon, and northern aplomado falcon) would not be affected by secondary hazards resulting from use of this compound.

Aquatic. Results based on the exposure modeling in surface water (using EXAMS) to calculate exposures of freshwater fish to 4-AP indicate little potential hazard. The corresponding acute HQ for aquatic exposures is 0.01, based on a maximum short-term water concentration of 0.29 ug/L, and a HQ of 0.01, based on a 28-day water concentration of 0.18 ug/L.

(6) Uncertainty Analysis

This product was subjected to quantitative sensitivity and uncertainty analysis relating to its potential for off-site transport. This analysis was conducted concurrently for other epresentative scenario products as well and was discussed in the analysis of off-site transport potential.

(7) Conclusions

Primary Toxicity: Potential effects are possible for both acute and chronic exposures, based on high toxicity, persistence, and small difference between acute/chronic benchmark for the indicator species (eastern meadowlark). This product may potentially affect other nontarget granivorous birds that occur in ripening fields where the bait is applied, including three listed species (Aleutian Canada goose, Attwater's greater prairie chicken, and whooping crane) occurring within the range of use of this formulated product.

Secondary Toxicity: No probable risk is expected, based on low concentrations and low HQ value for the indicator species (American kestrel), including three listed species (bald eagle, peregrine falcon, and northern aplomado falcon) occurring within the range of use of this compound.

Aquatic: No probable risk is expected, based on low concentrations and low HQ value.

(8) Comparison of Findings with Those of USFWS and USEPA

Both USFWS and the risk assessment concluded that use of Avitrol may adversely affect the three listed species, Aleutian Canada goose, Attwater's greater prairie chicken, and whooping crane (USFWS 1979, USFWS 1992). The biological opinion of USFWS is that the APHIS ADC program is not likely to jeopardize the continued existence of these three species, although use of Avitrol is restricted where whooping cranes and Attwater's greater prairie chickens are known or believed to be present (USFWS 1979, USFWS 1992). Avitrol could adversely affect the Aleutian Canada goose if ingested, but is not likely to jeopardize this species (USFWS 1992).

Because no probable risk is expected, USFWS did not address potential impacts of secondary toxicity to threatened or endangered species of raptors (northern aplomado falcon, bald eagle, and peregrine falcon). This formulated product was not considered in USEPA's Request for Section 7 Consultation (USEPA 1991b).

(9) Mitigation

Although the indicator species (eastern meadowlark) indicated evidence of elevated potential for adverse acute and chronic exposures via primary ingestion, all labels currently specify that where uneaten bait may be a hazard to other birds or animals, it should be picked up at the end of each day. This specification is expected to reduce potential exposures to nontarget birds, although it is not expected to eliminate all exposures during baiting, because, in some cases, it is impractical to remove uneaten bait.

No mitigation measures are recommended for the whooping crane and Attwater's greater prairie chicken because, according to the 1979 and 1992 biological opinions, the use of Avitrol is restricted within the range of these two species. USFWS does establish reasonable and prudent measures to minimize potential impacts to the Aleutian Canada goose: (1) to prohibit use of Avitrol within known or likely habitats of the subspecies in nine California counties and three Oregon counties; and (2) to the Anchorage USFWS Regional Office for review and approval to submit proposals to use Avitrol on breeding grounds (USFWS 1992). One additional appropriate mitigation measure may be to prohibit use of Avitrol within known or likely habitats of the subspecies in Washington State as well.

e. 4-Aminopyridine (Avitrol Concentrate), 25 percent

(1) Use Pattern

This product was applied in two States (KY and TN) between FY 1988 through 1991. It is a flock-alarming poison used to control gulls where they feed, nest, and roost. The product was applied at power-producing dams, navigational locks, and landfills (Garner, K., Personal communication, April 1992) by approximately 14 APHIS ADC program employees. In 1991, 0.35 pound of Avitrol concentrate containing 0.09 pound a.i. was applied within these two States in the form of bread cubes. The USEPA registration label for this formulation limits the maximum application for each site to 1 g for a maximum frequency (not specified on the label of the formulation used but estimated from a similar label) of once per week for 5 weeks. Prebaiting is required for this method with up to three baited bread cubes placed at each site. Avitrol concentrate has been used by APHIS ADC year-round. Nontarget animals are not expected to be affected by the use of this compound because the application is very specific and an employee is present during the baiting operation.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Avitrol concentrate is applied at power-producing dams, navigational locks, and landfills to control damage by gulls (Garner, K., Personal communication, April 1992). There are no other known habitats that could be involved with this product.

Primary Nontarget Hazards. No nontarget animals have been affected by past applications of Avitrol concentrate because the use is very specific and an employee is present during the baiting operation (Garner K., Personal communication, April 1992). Potential nontargets include crows, starlings, and other birds likely to occur with gulls at industrial sites and landfills.

Secondary Nontarget Hazards. Secondary hazards are not likely to occur because affected birds are generally removed from the area following bait application.

Domestic Animals. Domestic animals would not be affected by use of this formulated product.

Threatened and Endangered Species. No listed species occurring in Kentucky or Tennessee would be affected because they are unlikely to feed on bait applied in industrial areas or landfills.

(3) Screening

The cumulative score for the 25 percent concentrate formulation of 4-aminopyridine was 38, indicating that QRA was warranted. The key area contributing to more than half of this score was the toxicity component; this aspect of 4-AP has been addressed for the 0.5 percent formulated product. Minimum nontarget exposure potential contributed overall to a lower score than the 0.5 percent formulation.

(4) Exposure Assessment

Indicator Species and Exposure Factors. The American crow was selected as the potentially affected species, a representative indicator species for landfills and other areas of use. The crow is a year-round resident in the two States of concern. It inhabits open and semi-open habitats, including suburban areas and parks. This omnivorous bird feeds on grains, seeds, and fruit, along with insects, small reptiles, eggs, and young birds (DeGraaf et al. 1991). Its body weight ranges from 350 g to 600 g (Long 1981), and its home range is reportedly as large as 37 miles per day (Brown 1985).

Exposure Factors. The American crow was assumed to be exposed through primary ingestion of bait, with the actual dose of the bird calculated based on the ingestion of one bread cube (a normal dose); the ingestion rate is therefore not relevant. The percent of grain/seed eaten in the diet was estimated to be about 50 percent. The home range (20 acres) was determined to be large with respect to the application area (10 acres).

(5) Risk Characterization

Primary. Results for the American crow, a nonlisted species, suggest evidence of potential acute toxic exposures based on ingestion of bread baits, supported by an acute HQ value of 1,500 (see Table P-27). This elevated value was based primarily on: (1) high orders of both acute toxicity to nontarget organisms; and (2) high concentrations of the active ingredient on a single bread bait (167 mg active) to be ingested during one event.

Exposure factors supporting these calculations were designed to be conservative and also contributed to elevated HQ values. For example, the limited home range (approximately 20 acres) assumes 50 percent potential exposure; large numbers of birds would not normally be expected to feed from this limited range. It is also noted that 4-AP is a lethal repellent and that other nontarget individual birds would thus be deterred. These calculations also assumed that the ingestion of an entire treated bread bait occurred at the application site.

The soil pathway was also considered for primary exposures, as with the 0.5 percent bait, on the assumption that incidental ingestion of contaminated soil occurs while ingesting bait. Similar to this concentration, the contribution from the soil pathway was found to be relatively insignificant for the concentrate formulation, as indicated by the HQ value of less than 0.01.

Chronic HQ values were not calculated using this indicator species due to high levels of acute toxicity potentially occurring from ingestion of one bread bait; the greatest potential for the occurrence of toxicity is expected to occur via acute exposures.

Results of the quantitative risk assessment suggest that potential hazards exist for birds consuming 4-aminopyridine treated bread bait, especially in such areas of application as landfills. This potential is not frequently observed, however; no nontarget hazards have been specifically reported for any birds because of the hand application of this end-use formulation.

(6) Conclusions

Primary Toxicity: "Probable risk", based on the elevated HQ value however, the application is very specific, which reduces potential exposure pathways.

Secondary Toxicity: No probable risk expected because of target specificity and removal of affected birds.

Aquatic: no probable risk expected, based on low concentrations and low HQ value for the representative scenario. Additionally, minimal off-site transport is assumed, based on single bread cube baiting.

(7) Comparison of Findings with Those of USFWS and USEPA

This formulated product was not considered in the Biological Opinions or the Request for Section 7 Consultation (USEPA 1991b).

(8) Mitigation

Although the indicator species (American crow) indicated evidence of elevated potential for adverse acute exposures via primary ingestion, the label currently specifies that uneaten bait be removed from the application site by the end of the day. The label also states that it should not be used when nontarget birds are feeding in the area. These specifications are expected to reduce potential exposures to nontarget birds therefore; no mitigation is recommended.

f. DRC-1339 — $C_7H_9NCL_2$; CAS #7745-89-3

(1) General Discussion

DRC-1339 is a slow-acting avicide that is widely used throughout the United States. It is lethal in a single feeding; however, prebaiting is usually necessary to gain bait acceptance by the target species. DRC-1339 is available as a concentrate (98 percent a.i.) that may be formulated with grain, bread, french fry, egg, or meat baits. It is also commercially available in ready-to-use pellet form as Starlicide Complete (0.1 percent a.i.). APHIS ADC personnel used DRC-1339 mostly on grain baits at feedlots to reduce consumption and contamination of livestock forage by starlings and blackbirds.

(2) Use Patterns

In the United States, DRC-1339 concentrate may only be formulated and applied by APHIS ADC personnel trained in bird damage control or persons under their direct supervision. Commercially available Starlicide Complete may be used by APHIS ADC personnel as well as by others who are State-certified in pesticide application. A total of 104 APHIS ADC program employees used one or more DRC-1339 products in 23 States

throughout the United States in direct control activities during FY 1988 through 1991 (Table P-7). Maximum annual use of all formulations (including Starlicide Complete) during these years totaled 150 pounds of active ingredient. DRC-1339 is used throughout the year, but use is greatest during the winter. Approximately 80 percent of APHIS ADC State program use of DRC-1339 during 1988 - 91 occurred on private lands; the remainder was on public lands.

(3) Environmental Fate

DRC-1339 is very soluble in water (91,600 mg/L). The K_{oc} for this chemical ranges from 124 to 137 (Schafer, E., Personal communication, March 31, 1992). The high solubility and low K_{oc} values indicate that this chemical would be moderately to highly mobile. DRC-1339 is not persistent in soils, because it degrades rapidly in aerobic and anaerobic soils. The reported anaerobic soil half-life is less than 2 days (Schafer, E., Personal communication, March 31, 1992); no other data available. Because of its moderately high mobility and low persistence, DRC-1339 residues are not expected to accumulate in soils between applications.

DRC-1339 is somewhat volatile and is susceptible to degradation by both ultraviolet radiation and heat (Schafer 1990f). In laboratory studies conducted by the DWRC, between 25 and 100 percent of DRC-1339 residues initially present in aqueous solutions that were placed on Teflon surfaces were lost to the atmosphere within 24 hours. The percent lost varied with the initial concentration of the compound (Broyles 1991). Studies of the photolysis of DRC-1339 have only imperfectly characterized the rate of photodegradation. Between 33 and 40 percent of the DRC-1339 initially present was lost from aqueous solutions placed in capped tubes and exposed to a 275-Watt ultraviolet sun lamp for nine hours. However, the degradation products collected from these tubes represented only a fraction of the DRC-1339 lost (Broyles 1991). Other laboratory studies suggest that this compound is not susceptible to hydrolysis under the pH conditions typically encountered in the environment. (Kimball et al. 1991).

DRC-1339 is rapidly metabolized and excreted in birds and other species and is apparently not accumulated in plant or animal tissues (Schafer 1991a).

Evaluation of Off-Site Transport Potential. The active ingredient DRC-1339 is used in widely varying formulations throughout the country by the APHIS ADC program each year, all of which are ground applications. Thus, although different formulations are involved, this analysis has been conducted on the basis of the active ingredient. The hydrochloride salt of the technical grade material is highly soluble, and as suggested by the soil sorption coefficient and other properties, the potential for the material to be transported to off-site surface water and groundwater after application may be high.

As noted above, DRC-1339 degrades rapidly under both aerobic and anaerobic conditions in soils (half-life of less than two days) (Schafer personal communication 1992). This is a key point in determining transport potential for this material because if the half-life is short and the material is only applied infrequently, accumulation in soils between applications will be less likely to occur. A subsequent portion of the risk assessment will discuss whether initial concentrations, especially if applied under moist or rainy conditions, could increase the potential for nontarget exposures. The degradation process is likely to diminish concentrations before the chemical migrates to groundwater. However, off-site transport via surface water runoff or erosion could occur if this material is applied during the rainy season.

(4) Toxicology

This well-documented compound is highly toxic to starlings, blackbirds, and magpies, with reported LD_{50} values ranging from 1 to 5 mg/kg. Doves, pigeons, quails, chickens, ducks, and geese are slightly less sensitive and have acute toxicity values occurring in the range of 11 - 100 mg/kg. Most of the target species are adversely affected at low levels.

Few birds and most mammals experience toxicity at higher levels ranging from 100 to more than 1,000 ppm. DRC-1339 may be chronically toxic to sensitive species, although the compound is metabolized rapidly (Schafer 1984). Most LC_{50}s for aquatic organisms range from 6 to 18 mg/L, which would be regarded as low to moderate toxicity.

Metabolism. Based on the comparative toxicity of oral and intravenous doses, DRC-1339 is absorbed readily into the starling circulatory system (Decino et al. 1966; Felsenstein et al. 1974). This compound is readily metabolized in the liver into related compounds, possibly including glucuronides and mercapturides. The compound is completely metabolized within three to 24 hours, with the target species dying as soon as three hours after consuming the bait (Decino et al. 1966; Cunningham et al. 1979). Uric acid deposits build up in the kidney and blood vessels causing necrosis and circulatory impairment, and resulting in death from uremic poisoning and congestion of major organs (Decino et al. 1966; Felsenstein et al. 1974). In mammals, toxic effects include central nervous system depression along with muscular weakness (Felsenstein et al. 1974). The principal toxic effect in mammals is thought to be methemoglobinemia (Felsenstein et al. 1974).

Primary Toxicity. This avicide is more toxic to birds than to mammals, which serves to increase specificity to target species (Decino et al. 1966). Toxicity to starlings, blackbirds, crows, and jays occurs from 1 to 10 ppm, with LD_{50}s reported from 1 to 3 ppm in the APHIS ADC literature. Doves, pigeons, quails, chickens, ducks, and geese experience toxicity levels ranging from 11 to 100 ppm, and they are somewhat more resistant to DRC-1339 than such target species as blackbirds and starlings (Schafer 1970a; Felsenstein et al. 1974). The larger size of ducks and pheasants appears to contribute to the lower susceptibility to the avicide (Decino et al. 1966). Most avian species are adversely affected at low levels, as shown in Table P-11. Possible exceptions to this include hawks, sparrows, and finches (Schafer and Cunningham 1967). These birds and most mammals have toxicities ranging from 101 - 1,000 ppm (Schafer 1970a; Schafer et al. 1977; Decino et al. 1966; Felsenstein et al. 1974).

DRC-1339 is a chronic toxicant to sensitive species, even though it is metabolized rapidly (Schafer 1984). Chronic toxicity studies involving five avian species for up to 120 days indicated that DRC-1339 is cumulatively toxic to birds. The lowest feed concentration that produced an LC_{50} value was 1 ppm (0.3 mg/kg-d) for the starling over a duration of 90 days (Schafer et al. 1970). This same study investigated the reproduction of coturnix quail, which was adversely affected at levels of 10 ppm (6.23 mg/kg-d) in the diet. The endpoints determining adverse effects include egg breakage and decreased egg and live chick production. Fletcher and Pedersen (1991a) found a 21-day NOEL for the bobwhite quail at 1.47 mg/kg-d, four times lower than the lethal dietary dose. For pigeons, chronic DRC-1339 ingestion resulted in an increased amount of infertile eggs. Chronic carcinogenic bioassays using rats indicated incidences of uterine tumors, but are not convincing evidence for carcinogenicity of DRC-1339 (Anonymous 1978).

Secondary Toxicity. There is little potential for secondary hazards to nontarget animals with this compound, primarily due to the rapid metabolism of the compound. The only report of secondary toxicity occurred when crows consumed the gut contents of pigeons killed with Starlicide (Schafer 1984). Cunningham et al. (1979) estimated that a sensitive species (i.e., cat, owl, and magpie) could be at risk only if its diet consisted wholly of DRC-1339-poisoned starlings for more than 30 continuous days.

Human toxicity indicates harmful affects via ingestion and dermal contact, but no apparent carcinogenic effects. Dermal routes could potentially be harmful, with chronic exposure resulting in methemoglobinemia.

Aquatic Toxicity. Data indicate low aquatic and invertebrate toxicity. Results from Marking and Chandler (1981) and Blasberg and Herzog (1991) indicate that aquatic toxicity of DRC-1339 to water fleas occurred at 1.6 mg/L for a 48-hr EC_{50}. The majority of LC_{50}s ranged from 6 to 18 mg/L for such species as glass shrimp, snails, crayfish, and

Asiatic clams (Marking and Chandler, 1981). In an APHIS ADC file compiled by Schafer (no date), LC_{50} values determined for bluegill and catfish ranged from 21 to 38 mg/L.

Benchmark Values. Benchmark values were determined for the five indicator species identified in the Exposure Assessment section, including three birds (passerine and two raptors), a mammal, and a freshwater fish. Surrogate species were then selected based on available toxicology and similar physiology to the indicator species. The benchmarks derived are listed in Table P-23. The starling was used as a surrogate for extrapolating both acute and chronic benchmarks to protect the northern cardinal. The starling is known to be highly sensitive to DRC-1339; the benchmark value should be a conservative estimate with respect to other avian species.

The 90-day chronic study by Schafer (1970b) found the starling to be most sensitive chronically, with the quail close to this value (0.75 mg/kg-d). The marsh hawk was used as the surrogate for the American kestrel and the golden eagle was used as the indicator species for analysis of the egg and meat bait formulation. The marsh hawk was the most sensitive of the raptors studied (Decino et al. 1966). The same study was used to calculate the chronic benchmark because no other chronic raptor studies were available. The mammalian indicator (coyote) was represented by the dog, which appeared to be the most sensitive of the mammals tested. No chronic extrapolation was necessary, assuming the animal consumes all the bait at once.

The cumulative uncertainty factor for protecting the northern cardinal from acute hazards was estimated to be 15, which resulted in an acute benchmark value of 0.21 mg/kg. The chronic benchmark resulted in an uncertainty factor of 30 due to extrapolation from subchronic lethality to a chronic NOEL. The resulting benchmark was 0.01 mg/kg-d. The cumulative UF for the kestrel was 45, because the endpoint of lethality was not as sensitive as a median lethality value. The final acute benchmark was estimated to be 2.22 mg/kg.

The final, conservative, chronic benchmark value established for the kestrel (and golden eagle) was 0.44 mg/kg-d, produced from a large UF value of 225. The benchmark value for the coyote indicator was determined to be 0.71 mg/kg, based on a UF value of 100. The surrogate for freshwater fish was the most sensitive aquatic species found (daphnid) and was assigned a UF value of 18, which yielded a final benchmark value of 0.09 mg/L.

g. DRC-1339 Feedlots, 98 percent, and Starlicide Complete, 0.1 percent

(1) Use Pattern

DRC-1339, 98 percent, feedlots. This end-use formulation for feedlots uses 98 percent DRC-1339 diluted to approximately 0.1 percent active ingredient prior to application. The formulation is used to control damage to resources by blackbirds, starlings, pigeons, and grackles in cattle, swine, and poultry feedlots. This formulation was used under the Federal registration in nine States (GA, ID, MS, NM, NV, OR, UT, VT, WV) and in Arizona and Washington under FIFRA Section 24(c) registrations. Approximately 50 APHIS ADC program employees used this restricted use product on primarily rural private land, although it was applied on public land in at least three States. The annual use ranged from 0.5 g (0.48 g a.i.) in Georgia to 67 pounds a.i. in Arizona. This formulation is usually applied during winter, although small amounts were used during spring, summer, and fall. The maximum application rate permitted by the label is 4 g a.i. per 100 m^2.

DRC-1339 (Starlicide Complete), 0.1 percent. Starlicide Complete, similar to DRC-1339 used in feedlots although it is not a restricted use pesticide, contains 0.1 percent DRC-1339 and is federally registered for the control of starlings and blackbirds. During FY 1988 through 1991 approximately six APHIS ADC program employees applied this product in New Jersey and Washington. The maximum annual use in these two States

was 200 pounds (0.2 pound a.i.) and 970 pounds (0.97 pound a.i.), respectively. The maximum application rate is 50 pounds of product per acre, over a maximum of three days of application. This method was used primarily during the winter and to a lesser extent in the fall on rural, private land.

(2) Potentially Exposed Nontarget Species

Primary Nontarget Hazards. Many granivorous bird species occurring in feedlots could be affected by consumption of DRC-1339 grain bait. DRC-1339 poses little primary risk to mammals. The formulation was originally developed to control starlings only. Birds that were adversely affected by use of the starling-control agent included American crows, Brewer's blackbirds, red-winged blackbirds, and brown-headed cowbirds (Besser and DeGrazio 1965; Royall et al. 1967; Hickman 1968). These bird species are now identified as targets under the current registration.

Besser and DeGrazio (1965) reported the following results after DRC-1339 was applied at 58 sites in seven States: a total of 38,442 dead birds were collected, of which 37,865 (98.5 percent of the total) were starlings or blackbirds. The remaining 577 dead birds included 377 cowbirds, 27 magpies, one meadowlark, one cardinal, and six grackles. The authors estimated that 800 house sparrows were also killed, but state that this estimate may be in error, because DRC-1339 is relatively nontoxic to this species, and none were collected at baited feedlots even though sparrows usually reside at feedlots.

Other reports of nontarget bird species found dead following application of DRC-1339 in feedlots are as follows: one northern flicker, one dark-eyed junco, one northern cardinal, and one eastern meadowlark in Kentucky (Knittle et al. 1980); one western meadowlark in Nevada (Alcorn 1965); and five house sparrows in Colorado and Nevada (Besser and Guarino 1962, Besser 1964, Fitzwater 1965). Additional bird species, such as ring-billed gulls, red-bellied woodpeckers, blue jays, and white-crowned sparrows, were observed foraging at the bait sites, but were not found dead at the bait sites or in adjacent roosts (Royall et al. 1967; Hickman 1968; Knittle et al. 1980; Stickley 1979). However, DRC-1339 is a slow-acting avicide, so many more birds may be affected by consumption of bait and are not necessarily found after treatment is completed.

Additional bird species known to occur at or near bait sites but that were apparently unaffected include the American robin, brown thrasher, downy woodpecker, Gambel's quail, horned lark, killdeer, mallard, mourning dove, northern bobwhite, northern mockingbird, purple finch, rufous-sided towhee, savannah sparrow, song sparrow, tree sparrow, water pipit, and white-throated sparrow (Alcorn 1965, Besser and DeGrazio 1965, Royall et al. 1967, West 1968, Besser and Bray 1977, Knittle et al. 1980, Stickley 1979).

Secondary Nontarget Hazards. DRC-1339 poses little secondary hazard to predatory or scavenging animals because the compound is rapidly metabolized and excreted and is not accumulated (Schafer 1991a). Only one case of secondary poisoning has been reported from field studies: three American crows were found dead after consuming the stomach contents of pigeons killed with DRC-1339 at an oil refinery and air force base in California (Kreps 1979).

In other field studies, a wide variety of predators and scavengers were observed feeding on DRC-1339 poisoned birds, and no secondary effects were detected. These predators and scavengers included turkey vultures, Cooper's hawks, northern harriers, red-tailed hawks, short-eared owls, great horned owls, black-billed magpies, coyotes, gray foxes, opossums, raccoons, striped skunks, and domestic cats (Besser 1964; Guarino 1964; Royall et al. 1967; Glahn et al. 1990; Knittle 1992).

Laboratory studies indicate that some species (owls and magpies, for example) are sensitive to DRC-1339 intoxication (Cunningham et al. 1979). However, based on the low level of toxicity, the possibility of chronic intoxication is negligible. Cunningham et al. (1979) estimated that a sensitive species would be at risk only if its diet consisted wholly of DRC-1339-poisoned starlings for more than 30 continuous days.

Domestic Animals. Domestic livestock could be affected by application of DRC-1339 in feedlots if the bait is placed in areas accessible to foraging livestock. One occurrence of adverse impacts to domestic animals has been reported: two domestic chickens were found dead after DRC-1339 treated poultry pellets were applied in feedlots to control blackbirds (Besser 1964).

It is unlikely that domestic cats and dogs would be affected by secondary poisoning, and based on the low toxicity of the pesticide, the probability of chronic intoxication is negligible (Cunningham et al. 1979).

Threatened and Endangered Species. Two listed species, the Aleutian Canada goose and whooping crane, would potentially be affected from consumption of DRC-1339-treated grain in feedlots. Use of this formulated product in feedlots is not specifically restricted within the range of these two species. Two additional listed species, the bald eagle and peregrine falcon, could be affected by secondary toxicity from consuming prey poisoned by DRC-1339. Use of DRC-1339 is not specifically restricted within the range of these listed species.

(3) Screening

These two end-use formulations of DRC-1339 were designated as warranting QRA based on total scores (58 for the feedlot formulation and 51 for Starlicide Complete). DRC-1339 is acutely and chronically toxic to a variety of mammalian, avian, and aquatic species, and as such these properties tended to add to the total scores for all formulations. Potential exposures to threatened and endangered species were also a key consideration and varied by formulated product. Environmental fate properties (e.g., low persistence and bioaccumulation potential) as well as use pattern characteristics were relatively insignificant and did not materially affect the screening outcome.

(4) Exposure Assessment

Indicator Species and Exposure. The representative scenario, DRC-1339 in staging areas, provides details of the indicator species and other exposure considerations. An additional species, the eastern meadowlark, was used to further define the exposure to this end-use formulation. The exposure factors for the meadowlark were delineated for the Avitrol 0.5 percent grain bait and assumed to be the same for this formulated product.

(5) Risk Characterization

Primary. Initial results for the eastern meadowlark suggest evidence of highly toxic acute exposures based on ingestion of grain bait, supported by an acute HQ value of 234. The results also indicate highly toxic chronic exposures to grain bait supported by a hazard quotient of 221. These elevated values were close to an order of magnitude less than the representative scenario, due primarily to the reduced concentrations in bait (1 percent for feedlots and Starlicide).

Results of the quantitative risk assessment suggest that potential hazards exist for any birds consuming DRC-1339 treated grain bait. Hazards are highest to granivorous bird species that are likely to forage in feedlots where the bait is applied. Nontarget hazards have been specifically reported for dark-eyed juncos, meadowlarks, sparrows, magpies, cardinals, and flickers.

Primary hazards to the two potentially exposed listed species, the Aleutian Canada goose and whooping crane, are highly unlikely because these two species do not frequent the feedlots where the bait is applied.

Secondary. Refer to staging area (representative scenario) analysis (p. P-206).

Aquatic: Refer to staging area (representative scenario) analysis (p. P-206).

(6) Conclusions

Primary Toxicity: This formulation could potentially affect nonlisted nontarget bird species, based on elevated acute and chronic HQ values for the eastern meadowlark. A no probable risk conclusion for the Aleutian Canada goose or whooping crane was determined because they are unlikely to frequent feedlots where the bait is applied.

Secondary Toxicity: No probable risk is expected, based on low prey concentrations and low HQ value for the American kestrel, including no probable risk on potentially exposed listed species (bald eagle and peregrine falcon).

Aquatic: No probable risk is expected for aquatic organisms, based on low concentrations and low HQ value of the representative scenario.

(7) Comparison of Findings with Those of USFWS and USEPA

USFWS concluded that use of DRC-1339 or Starlicide may adversely affect two species, the Aleutian Canada goose and the whooping crane (USFWS 1979; 1992). This conclusion differs from the risk assessment conclusion that these two species would not be affected because they are unlikely to occur in feedlots where the bait is applied. However, USFWS further concludes that the existence of these two species would not be jeopardized because use of DRC-1339 is restricted to APHIS ADC employees. Only the starlicide formulation is available to others (USFWS 1979; 1992).

Because DRC-1339 poses little secondary hazard the USFWS did not address potential impacts of secondary toxicity to threatened or endangered species of raptors (bald eagle and peregrine falcon).

This formulated product was not considered in USEPA's Request for Section 7 Consultation (USEPA 1991b).

(8) Mitigation

No mitigation measures are recommended for the whooping crane and Aleutian Canada goose because, according to the 1979 and 1992 biological opinions, the use of DRC-1339 and Starlicide is restricted within the range of these two species.

h. DRC-1339, 98 percent, Structures

(1) Use Pattern

This formulation contains 98 percent DRC-1339 diluted to 0.1 to 0.5 percent a.i. and is used for the control of starlings, pigeons, crows, and grackles in structures. It was used in seven states (GA, IL, IN, KY, MI, NM, TN) under State and local need (FIFRA Section 24(c)) registrations. Approximately 44 APHIS ADC program employees used this method. The maximum annual use ranged from 1.2 g (1.18 g a.i.) in Georgia to 6303 a.i. in Kentucky. The maximum application rate varied between States, ranging from 25 to 100 pounds prepared bait per acre. This formulation was applied throughout the year primarily on private lands.

(2) Potentially Exposed Nontarget Species

Primary Nontarget Hazards. Potentially affected nontarget species include birds and small mammals occurring in or adjacent to buildings where DRC-1339 is applied. Birds found dead after bait was applied on rooftops to control pigeons and starlings in Ohio included one house sparrow and two mourning doves (Smith 1969). Other potential nontarget receptors that could be affected, based on their occurrence in developed areas and consumption of grain, include the brown thrasher, northern cardinal, northern mockingbird, rufous-sided towhee, sparrows, squirrels, and rabbits (USDA 1988a, 1991f).

Secondary Nontarget Hazards. Secondary hazards to nontarget animals are the same as listed above for DRC-1339, 98 percent, feedlots.

Domestic Animals. Application of DRC-1339 on structures is unlikely to present a hazard to domestic livestock or poultry. Domestic cats and dogs may be exposed to DRC-1339 secondarily, but based on the low toxicity of the pesticide, the probability of chronic intoxication is negligible (Cunningham et al. 1979).

Threatened and Endangered Species. No listed species would be affected by consumption of bait applied on structures, because none that would consume 1339-treated baits are likely to occur in urban areas where the bait is applied. Two listed species, the peregrine falcon and bald eagle, could potentially be exposed to secondary toxicity from consuming DRC-1339-poisoned prey, although the likelihood of this occurring is minimal. Use of DRC-1339 is not specifically restricted within the range of these listed species.

(3) Screening

This formulation of DRC-1339 was designated as warranting QRA based on the cumulative score of 49. The scores for the active ingredient, DRC-1339, for both environmental fate and toxicity were the same as for the feedlots. Potential exposures to threatened and endangered species were a key consideration for this formulated product.

(4) Exposure Assessment

Indicator Species and Exposure. The house finch was used as the indicator for this DRC-1339 end-use formulation. This species occurs year-round in the States of use and is likely to be in structures where this formulation is used. The home range of the house finch is reportedly limited to approximately 0.8 acre.

Exposure Factors. The relevant factors for the house finch include the body weight (22 g) and the ingestion rate (4.4 g/d). The percent of range in the area of application was assumed to be 100 percent because of the small home range, and the amount of grain eaten was assumed to be 50 percent, as with other small birds delineated previously.

(5) Risk Characterization

Primary. Results for primary exposure to the house finch in structures suggest evidence of highly toxic acute exposures based on ingestion of grain bait, supported by an acute HQ value of 1,734. The results also indicate toxic chronic exposures to grain bait (3,700 mg/kg), supported by a hazard quotient of 1,635. These results are similar to the representative scenario and suggest potential the possibility for occurrence of nontarget effects if no steps are taken to minimize potential hazards. Label specifications regarding prebaiting and not using when nontargets are feeding off the prebait are important steps for minimizing potential hazards.

As noted above for other formulations, risk assessment results suggest that potential hazards exist for birds consuming DRC-1339-treated grain bait. Hazards are highest to granivorous bird species that are likely to forage on structures where the bait is applied. Nontarget hazards have been specifically reported for mourning doves and sparrows. Overall, hazards are lower for this DRC-1339 product, because fewer bird species are likely to occur in urban areas where the bait is applied.

Primary hazards to listed species are unlikely to result from application of DRC-1339 in structures because no listed species that would consume treated bait are likely to occur in urban areas where the bait is applied.

Secondary. No analysis was considered necessary after the representative scenario was calculated because of the lack of effect. Refer to the staging area (representative scenario) analysis for details.

Aquatic. No analysis was considered necessary after the representative scenario was calculated because of the lack of effect. Refer to the staging area (representative scenario) analysis.

(6) Conclusions

Primary Toxicity: May potentially affect the house finch based on elevated acute and chronic HQ values. It may also potentially affect other granivorous bird species likely to consume grain bait applied in urban areas. A no probable risk determination for listed species was concluded because none that would consume treated bait are likely to occur in urban areas where the bait is applied.

Secondary Toxicity: No probable risk is expected, based on low prey concentrations and low HQ value for the American kestrel, including potentially exposed listed species (bald eagle and peregrine falcon).

Aquatic: No probable risk is expected, based on low concentrations and low HQ value of the representative scenario.

(7) Comparison of Findings with Those of USFWS and USEPA

This formulated product was not addressed in USFWS's Biological Opinions or USEPA's Request for Section 7 Consultation (USEPA 1991b).

(8) Mitigation

No mitigation was recommended for this end-use formulation. Existing label directions specifying prebaiting and bait removal are adequate to protect nontarget species.

i. DRC-1339, 98 percent, Staging Areas

(1) Use Pattern

This formulation contains 98 percent DRC-1339 (diluted to 0.5 percent a.i.) and is used for the control of damage caused by starlings, pigeons, and grackles in staging areas. It was used in 3 states (LA, ND, TX) under FIFRA Section 24(c). Approximately 44 APHIS ADC program employees applied this method. The maximum annual use in the 3 states totalled 22 pounds a.i. The maximum application rate varied between States, ranging from 25 to 100 pounds of treated bait per acre. This formulation was applied throughout the year, primarily on private lands.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. This formulation of DRC-1339 is applied in staging areas to control blackbird depredation of crops. Staging areas are defined as areas within 1 mile of roost sites, such as open fields, pastures, or orchards, where large numbers of blackbirds congregate as they approach their roost at night and again when they leave the roost in the morning. One staging area in Texas was described as a bare dirt field near a sugar cane field roost site (Tipton et al. 1989).

Primary Nontarget Hazards. Any granivorous birds occurring in staging areas where DRC-1339-treated bait is applied could be affected by use of this formulated product. Birds found dead after application of DRC-1339 in staging area fields include 13 northern

cardinals, two white-throated sparrows, one blue jay, one dark-eyed junco, one eastern meadowlark, one northern bobwhite, one northern flicker, and one varied thrush (Larsen and Mott 1968; Knittle et al. 1980; Cummings et al. 1992). Potential nontarget animals that were observed foraging in baited areas included ring-necked pheasants, mourning doves, horned larks, black-billed magpies, song sparrows, tree sparrows, white-crowned sparrows, squirrels, and rabbits (Larsen and Besser; 1963; West 1966; Ogden 1969; Winters 1969; Knittle et al. 1980). Any of these species may be affected by consumption of DRC-1339-treated bait, although none were found dead following bait application.

Other potential nontarget species that were observed in the vicinity of baited staging areas included the mallard, northern pintail, killdeer, ring-billed gull, downy woodpecker, red-bellied woodpecker, indigo bunting, northern mockingbird, brown thrasher, American robin, purple finch, rufous-sided towhee, bobolink, field sparrow, Lincoln's sparrow, savannah sparrow, swamp sparrow, vesper sparrow, house sparrow, and water pipit (West 1968; Stoll and Coon 1969; Knittle et al. 1980; Glahn and Heisterberg 1981; Glahn et al. 1990; Glahn and Wilson 1991; Cummings et al. 1992). None of these potential nontarget species were observed foraging in the baited areas, and none were found dead after application of the bait.

Secondary Nontarget Hazards. Secondary hazards to nontarget animals are the same as those identified above for DRC-1339, 98 percent, feedlots.

Domestic Animals. Application of DRC-1339-treated bait in staging areas could affect any domestic animals that occur in the staging areas and that are likely to consume the bait. No deaths of domestic animals have been reported following use of DRC-1339 in staging areas. In one study, hazards to domestic animals were eliminated by excluding livestock from the staging area before the bait was applied (West 1966).

Domestic cats and dogs may be exposed to DRC-1339 secondarily, but based on the low toxicity of the pesticide, the probability of chronic intoxication is negligible (Cunningham et al. 1979).

Threatened and Endangered Species. Two listed species, the Attwater's greater prairie chicken and the whooping crane, would potentially be affected from consumption of DRC-1339-treated bait applied in staging areas. Although the chances are minimal, two additional listed species, the bald eagle and peregrine falcon, could potentially be exposed to secondary toxicity from consuming prey poisoned by DRC-1339. Use of DRC-1339 is not specifically restricted within the range of these listed species.

(3) Screening

This formulation of DRC-1339 was designated as warranting QRA based on the cumulative score of 55. The scores for the active ingredient, DRC-1339, for both environmental fate and toxicity were the same as for the feedlot products. Potential exposures to threatened and endangered species were a key consideration for this formulated product, with a biological component score of 25.

(4) Exposure Assessment

(a) Indicator Species and Exposure Factors

The northern cardinal was selected as the indicator species for primary toxicity of DRC-1339 applied in staging areas. The cardinal occurs year-round in Louisiana, the selected indicator State for this product. Its diet, according to studies by McAtee (1908), consists of 45 percent grain and seed, 29 percent insects, and 24 percent wild fruit. The cardinal inhabits forest edges and brushy openings and is likely to occur in staging fields where DRC-1339 is applied. These factors (distribution, diet, and habitat) could promote exposure of the cardinal to application of DRC-1339 in staging areas. Empirical observations

further support the potential exposure: a total of 13 northern cardinals were found dead following application of DRC-1339 in staging areas in Kentucky, Tennessee, and Louisiana (Knittle et al. 1980; Cummings et al. 1992).

As with other DRC-1339 products, the American kestrel was selected as the indicator species for secondary toxicity of DRC-1339. Its habitat use, distribution, and diet promote the likelihood of exposure to secondary hazards resulting from consumption of DRC-1339-poisoned prey. No kestrels have been reported to be affected following application of DRC-1339, but they have been observed in the vicinity of areas baited with DRC-1339 (Besser and DeGrazio 1965; Knittle et al. 1980; Glahn and Heisterberg 1981).

Exposure Factors. Exposure factors for the northern cardinal were based on primary toxicity of DRC-1339 applied in staging areas. The cardinal was assumed to ingest approximately 15 percent of its body weight (6.47 g/d) (Kenaga 1973). The percentage of contaminated grain in the diet was assumed to be 50 percent for chronic exposures, but like other grain-eating birds, it could potentially consume 100 percent of its daily diet as grain. The exposure factors for the kestrel were outlined for 4-aminopyridine and vary only according to estimated pesticide body burden within prey species.

(5) Quantification of Exposure

Key Assumptions and Modeling Procedures. Five out of the six end-use formulations used by APHIS ADC in more than 15 States may impact several T&E species. The DRC-1339 98 percent concentrate (staging areas) was selected for use in the representative runoff scenario based on the criteria stated above. This formulation was applied in three States between FY 1988 and 1991: Louisiana, North Dakota, and Texas. The maximum application rate specified by the Louisiana State label for this formulation allows 100 pounds/acre (0.5 percent a.i.), which represents the highest rate (of the a.i.) among all States applying any of these formulations. Furthermore, the average annual rainfall in eastern Louisiana (Major Land Resource Area (MLRA): P-13B) is quite high, ranging from 103 to 135 cm per year (USDA 1981); Louisiana was therefore selected for the PRZM simulation.

Chemical properties of DRC-1339 used in PRZM included water solubility, soil half-life, soil K_{oc}, and vapor pressure, presented in Table P-19. A maximum application rate of 100 pounds/acre (0.5 percent a.i.) and maximum frequency of twice per year were used in the PRZM simulations to reflect conservative assumptions. The applications are assumed to take place on April 20 and May 1, 1953, to protect sprouting rice.

MLRA P-133B (eastern Louisiana) was again selected for the PRZM simulation, with "Desha" soil recommended by PIC/PRZM. The soil and hydrologic properties were those considered above for Avitrol, estimated using the PIC/PRZM program for DRC-1339 (see Table P-19). No breakdown products or daughter compounds of DRC-1339 were considered in the EXAMS modeling. The major processes considered for DRC-1339 are biodegradation and photodegradation. Hydrolysis of DRC-1339 was not considered because this compound is not susceptible to hydrolysis under conditions of typical pH (Schafer 1987; Kimball et al. 1991). Since few data regarding photooxidation of DRC-1339 were found, the degradation rates from photooxidation were assumed to be zero. Key parameters of DRC-1339 considered in the EXAMS modeling are provided in Table P-21.

(6) Results for the Quantitative Exposure Assessment

The results of the short-term (21 day) and longer-term (90 day) concentrations of DRC-1339 in surface soil (upper 2 cm) are presented in Figures P-7 and P-8. Figure P-7 also shows the runoff and erosion of DRC-1339 with each rainstorm. Unlike Avitrol, the major declines of DRC-1339 concentration in surface soil were caused by biodegradation instead of rainstorms (Figure P-7). The highest surface soil concentration of DRC-1339

was about 1.3 mg/kg, which occurred at the day of second application (May 1, 1953). This concentration rapidly declined by three orders of magnitude within three weeks (by May 20) (Figure P-8).

The estimated dissolved and sorbed concentrations of DRC-1339 in the water column and benthic compartments within the pond are shown in Figure P-9. Water column concentrations increased during the first 20 days (April 20-May 10) following field application in conjunction with rainstorms, because a significant amount of DRC-1339 residues was transported from the surface soil to the pond by the rainstorms during this period of time. The highest concentrations in the water column occurred at May 8: 0.029 mg/L dissolved and 0.2 mg/kg sorbed, which reflects a relatively high application rate. After this peak value, although the water column concentrations fluctuated depending on the amount of residue entering the pond, overall concentrations declined. After mid-June, few residues entered the pond, but the decline was already into the third (slow dissipation) stage.

DRC-1339 concentrations in benthic sediments started at zero (no direct loading to the benthic sediment) and increased with time until the end of July. The highest concentrations of DRC-1339 in sediment occurred at the end of July: 0.0048 mg/L in pore water and 0.066 mg/kg in sediment. The results indicated that the majority of pesticide mass remained in the water column rather than benthic sediment, which reflects its high solubility (Figure P-9).

The results presented in Figure P-9 also show that the dissolved and sorbed concentrations of DRC-1339 in the water column (or benthic sediment) are of the same shape. This reflects the partitioning of DRC-1339 concentrations between the sorbed and dissolved phases.

(7) Risk Characterization

Primary. Results for the northern cardinal suggest evidence of highly toxic acute exposures based on ingestion of grain bait, supported by an acute HQ value of 1,760. The results also indicate highly toxic chronic exposures to grain bait, supported by a hazard quotient of 1,660. These highly elevated values were based primarily on: (1) high orders of both acute and chronic toxicity to nontarget organisms; and (2) high concentrations in bait (5,000 mg/kg) at the time of application which attenuated, however, from time of application, based on aerobic degradation, and produced a lower chronic HQ.

Although estimated concentrations in bait are expected to attenuate appreciably following application, the high level of chronic toxicity to nontarget receptors contributed to sustained chronic hazard. The chronic risk characterization indicated that primary ingestion of bait is expected to account for virtually 100 percent of the risk; that is, if the bait source is removed, the chronic HQ value declines to less than 1.

Exposure factors supporting the above calculations again contributed significantly to elevated HQ values. For example, the limited home range of the northern cardinal (approximately three acres) assumes 100 percent exposure at all times. These calculations also assume that 50 percent of the daily ingestion rate (6.5 g/day) occurred at the application site and consisted exclusively of DRC-1339-treated grain. There is generally a much smaller difference between acute and chronic HQ values than is observed with 4-aminopyridine, suggesting a high order of both acute and chronic toxicity.

The contribution from the soil pathway to potential hazards to the northern cardinal is relatively insignificant, with a corresponding hazard quotient of 0.05 and 0.07 for acute and chronic exposures, respectively. These HQs are significantly less than the cumulative (all pathways) HQ values based primarily on bait ingestion. The contribution of the soil pathway to the golden eagle and coyote was not significant and did not exceed a HQ of 0.01.

Results of the quantitative risk assessment suggest that potential hazards exist for any birds consuming DRC-1339-treated grain bait. Hazards are highest to granivorous bird species that are likely to forage in staging area fields where the bait is applied. Nontarget hazards have been specifically reported for blue jays, dark-eyed juncos, meadowlarks, cardinals, flickers, and sparrows. These hazards can be minimized by baiting only where the target species (blackbirds) is concentrated, so that bait is consumed rapidly by the target species.

Primary hazards potentially exist for two listed species (whooping crane and Attwater's greater prairie chicken), resulting from application of bait in staging areas. The Attwater's greater prairie chicken is a year-round resident in southeast Texas, where it inhabits cultivated and uncultivated fields and forages on grains during fall and winter. This species could also be adversely affected by consumption of grain bait if DRC-1339 is applied within its limited range. The whooping crane winters in Texas and migrates through North Dakota. This species is known to occur in croplands and forage on grains. The whooping crane could be adversely affected by consumption of bait applied within its wintering or migratory range.

Secondary. The results for secondary exposure to the American kestrel suggest little potential hazard from consumption of contaminated avian species, with an acute HQ of less than 0.01. The maximum tissue concentration used was based on the pigeon, representing the highest projected body burden among all target species. These results indicate that chronic toxicity is of greater concern than acute toxicity, with a HQ of 0.02, contributed from the smaller chronic benchmark value (i.e., higher toxicity). This chronic HQ is conservative, based on the rapid metabolism of DRC-1339 prior to death. The contribution of the soil pathway to the kestrel was not significant and did not exceed a HQ of 0.01.

As noted above, the chronic risk characterization indicated that primary ingestion of bait is expected to account for virtually 100 percent of the risk. Based on these calculations, it does not appear that failure to remove dead target organisms would contribute materially to increased hazard.

Based on the results of the quantitative risk assessment, secondary hazards resulting from predators or scavengers consuming DRC-1339-poisoned prey are unlikely to occur. The three listed raptors (bald eagle, peregrine falcon, and northern aplomado falcon) occurring within the range of use of this compound would not be affected.

Aquatic. Results based on the exposure modeling in surface water (using EXAMS) to calculate exposures of freshwater fish to DRC-1339 indicate little potential hazard. The corresponding acute HQ for aquatic exposures is 0.23, based on a maximum short-term water concentration of 0.029 mg/L, and a chronic HQ of 0.28, based on a 10-day water concentration of 0.023 mg/L. The similar water concentration results from the fact that DRC-1339 degrades very slowly in water.

(8) Conclusions

Primary Toxicity. There is probable risk from both acute and chronic exposures, almost exclusively based on expected concentration (dose) in grain bait for acute and chronic exposure for the northern cardinal. This formulation may pose risks to other granivorous bird species likely to consume bait applied in staging areas. Also potentially at risk are two listed species (Attwater's greater prairie chicken and whooping crane) occurring within the range of use of this compound.

Secondary Toxicity. No probable risk is expected, based on low prey concentrations and low HQ value for the American kestrel, including no probable risk to three listed species (bald eagle, peregrine falcon, and northern aplomado falcon).

Aquatic. No probable risk is expected, based on low concentrations and low HQ value.

(9) Comparison of Findings with Those of USFWS and USEPA

This formulated product was not addressed in USFWS's Biological Opinions or USEPA's Request for Section 7 Consultation (USEPA 1991b).

(10) Mitigation

The 24(c) labels do not consistently require that uneaten bait be removed following application. The 24(c) labels IN900003, GA900008, UT890002, and MI910001 include this mitigation measure, while KY890003, TN890005, IL890006, and NM810003 do not specify such removal. It is recommended that this measure be included for all labels in order to reduce hazards to seed-eating nontarget birds. However, there still is the chance of nontargets being affected on the day of application. This is mitigated by the label provision for observation of nontarget birds, if any present during prebaiting. Treated bait should not be placed where nontargets are present or where the target species is not present. Where bait cannot be removed, a minimum dilution of 1:25 treated to untreated bait is recommended. In addition, bait carriers such as poultry pellets, dog food, and brown rice, that may be less attractive to nontarget,granivorous birds should be considered.

It is recommended that use of these formulated products in staging areas be restricted within the ranges for the whooping crane and Attwater's greater prairie chicken to protect these two species.

j. DRC-1339, 98 percent, Gull Toxicant

(1) Use Pattern

DRC-1339 gull toxicant is applied in coastal breeding areas within the predation radius of important nesting colonies of terns, puffins, laughing gulls, or other colonial nesting birds between March 1 and June 30. Gull toxicant was applied by a total of five APHIS ADC program employees in Maine, at the Petit Manan National Wildlife Refuge, and Massachusetts in FY 1988-91. This federally registered, restricted use formulation contains 98 percent DRC-1339. The concentrate is applied to bread cubes used for the control of great black-backed gulls and herring gulls. The maximum annual uses for these two States were 16 oz (5.7 oz a.i.) and 2.3 oz (2.25 oz a.i.). The maximum application rate is 100 g of DRC-1339 powder per 1,000 gulls. This method was used only during spring. No nontarget animals are affected by use of gull toxicant, because the bait is hand-placed only in active gull nests and gulls are territorial and prevent any other birds from approaching their nests to consume the baits (Butler, E., Personal communication, April 1992). The label also requires that uneaten bait and carcasses be picked up.

(2) Habitat Types and Potentially Exposed Nontargets Species

Habitat Types. DRC-1339 gull toxicant is applied in coastal breeding areas within the predation radius of important nesting colonies of terns, puffins, laughing gulls, or other colonial nesting birds between March 1 and June 30. This formulated product is used to reduce nest depredation by great black-backed gulls and herring gulls.

Primary Nontarget Hazards. Exposure to nontarget animals is minimal because bait is generally placed in active gull nests or in gull concentration areas (Woronecki et al. 1989). Starlings were observed consuming DRC-1339-treated bread bait applied at a dockyard along Lake Erie in Ohio, but no nontargets were reported to be adversely affected (Woronecki et al. 1989).

Secondary Nontarget Hazards. Secondary hazards are not likely to occur because affected birds are generally removed from the area following bait application.

Domestic Animals. Domestic animals would not be affected by use of this formulated product.

Threatened and Endangered Species. No listed species occurring in Maine or Massachusetts would be adversely affected by application of DRC-1339 Gull Toxicant.

(3) Screening

This DRC-1339 formulation has a low potential for nontarget effects due to the specific application directions on the label. The cumulative score derived through screening was 28, primarily due to the low nontarget effects. This formulation scored below the screening threshold of 35 and was therefore not evaluated further.

(4) Documentation of Results

Primary Toxicity. No probable risk is expected, based on screening score below the threshold and lack of nontargets.

Secondary Toxicity. No probable risk expected, based on no primary toxicity effect.

Aquatic. No probable risk expected, based on lack of significant transport potential.

k. DRC-1339, 98 percent, eggs/meat bait

(1) Use Pattern

This formulation uses 98 percent DRC-1339 in a powder added to eggs or meat for the control of ravens, crows, and magpies, primarily to prevent livestock depredation. It was used in seven States (AZ, CA, ID, NM, NV, OR, UT) under FIFRA Section 24(c) registrations. Up to 45 APHIS ADC program employees applied this formulation each year during FY 1988 through 1991. The maximum annual use of egg and meat baits ranged from 0.6 ounces in California to 0.45 pound (0.44 pound a.i.) in Nevada. The maximum application rate was for the egg baits, with 0.4 g per nest. This formulation was applied throughout the year.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. DRC-1339 eggs and meat bait is applied in a wide range of habitat types to control depredation by ravens, including livestock birthing pastures, waterfowl and shorebird nesting areas, desert tortoise habitat in high desert areas, and California least tern nesting habitat along the Pacific coast.

Primary Nontarget Hazards. Any egg-eating or carrion-eating animals occurring in areas where the bait is applied could be affected by consumption of DRC-1339 egg and meat bait. Only one nontarget species, the American crow, was found dead after application of egg and meat baits to control ravens at a large sheep farm in Oregon (Larsen and Dietrich 1970; Nelson et al. 1970). Golden eagles and coyotes were observed at egg and meat bait sites in Arizona, but the nontarget animals were flushed from the sites before they fed on the baits (Rubink 1986). During a field test of potential nontarget hazards in southern California, a striped skunk was the only animal that was observed consuming untreated eggs (Knittle 1992). Other potential nontarget receptors that may consume egg or meat bait include gulls, turkey vultures, roadrunners, ground squirrels, foxes, opossums, and raccoons (Grandy 1989; Knittle 1992).

There are several mitigating factors that reduce hazards to nontarget animals. In California, egg baits are placed five to six feet above the ground to eliminate hazards to nontarget mammals (Knittle 1992). In Arizona, baits are continually monitored throughout the baiting period, with nontarget predators flushed from the site (Rubink 1986).

Secondary Nontarget Hazards. Secondary hazards to nontarget species would be similar to those identified above under DRC-1339, 98 percent, feedlots.

Domestic Animals. Domestic animals are not likely to be affected by use of this formulated product.

Threatened and Endangered Species. Seven listed species occur within the range of use of this formulated product and could potentially be affected from consumption of DRC-1339-treated egg or meat baits: the bald eagle, California condor, grizzly bear, gray wolf, jaguarundi, ocelot, and San Joaquin kit fox. Use of DRC-1339 egg and meat baits is not specifically restricted within the range of any of these species.

(3) Screening

This formulation of DRC-1339 was designated as warranting QRA, based on the cumulative score of 50. The scores for the active ingredient, DRC-1339, for both environmental fate and toxicity were the same as for the feedlots. The amount of use was small (score of 4), producing a lower score than other DRC-1339 formulations. Potential exposures to seven threatened and endangered species were a key consideration for this formulated product, with a biological component score of 24.

(4) Exposure Assessment

The golden eagle and the coyote were selected as indicators for primary toxicity of DRC-1339 eggs and meat bait. Both the golden eagle and coyote might consume DRC-1339 eggs or meat bait applied in rangeland. Both species have been observed as nontargets at egg/meat bait sites in Arizona (Rubink 1986).

Exposure Factors. The golden eagle was assumed to be exposed through primary ingestion of the egg and meat bait coated with DRC-1339. The eagle ingests approximately 234 g/d (5 percent of its body weight), consisting of 12 percent grain, 12 percent birds and 5 percent carrion (McGahan 1968). The range of the eagle is large (approximately 3,520 acres) and is estimated to be in the vicinity of the point of application at least 50 percent of the time. The coyote ingests approximately 650 g/d, only 6.0 percent of its body weight (see Table P-22). The percent of range in which the coyote is expected to be exposed to egg and meat bait is approximately one percent of the four-square-mile minimum home range (Brown 1985).

(5) Risk Characterization

Primary. Ingestion of meat or egg baits by the golden eagle and coyote suggests little evidence of acute or chronic toxicity, supported by low acute and chronic HQ values of 0.16 and 0.8, respectively, for the eagle and acute and chronic HQ values of 0.2 and 0.4 for the coyote. These low HQ values were attributable to: 1) the fraction of meat (i.e., carrion) in their diets; 2) the fraction of range where the bait is applied (3 percent and 1 percent, respectively); and 3) the low order of toxicity in comparison with passerines.

Results of the quantitative risk assessment for egg and meat baits indicate that primary hazards to nontarget animals are unlikely to occur. No deaths of nontarget animals were reported in the literature or by the APHIS ADC program during FY 1988. Hazards to the seven listed species (California condor, bald eagle, San Joaquin kit fox, grizzly bear, gray wolf, jaguarundi, and ocelot) occurring within the range of use of this compound are unlikely to occur because the acute and chronic HQ values were less than one for the indicator species (golden eagle and coyote).

Secondary. Refer to staging area (representative scenario) analysis (p. P-206).

Aquatic. Refer to staging area (representative scenario) analysis (p. P-206).

(6) Conclusions

Primary Toxicity. No probable risk is anticipated from egg or meat baits because the HQ values were below one. No probable risk is expected for seven listed species (California condor, bald eagle, San Joaquin kit fox, grizzly bear, gray wolf, jaguarundi, and ocelot) occurring within the range of use of this compound.

Secondary Toxicity. No probable risk is expected, based on low HQ values calculated for the representative scenario and the low primary hazards.

Aquatic. No probable risk is expected, based on low concentrations and low HQ value of the representative scenario.

(7) Comparison of Findings with Those of USFWS and USEPA

This formulated product was not addressed in USFWS's Biological Opinions or USEPA's Request for Section 7 Consultation (USEPA 1991b).

(8) Mitigation

The labels for the egg and meat baits provide guidance for picking up unused bait, with one State (Arizona) requiring that the meat baits must be physically observed throughout the baiting period, therefore providing optimum protection to potential nontargets. No mitigation measures are necessary to protect listed species because none are likely to be affected by these formulated products.

I. Fenthion — $C_{10}H_{15}O_3S_2P$; CAS # 55-38-9

5.4.1 Fenthion BCF#1, 9 percent and Rid-A-Bird 11 percent formulations.

(1) General Discussion

This organophosphate compound is also used as an insecticide and, in such applications has been applied aerially in the United States and other countries. Over half of the fenthion used in the United States is for mosquito control, with a substantial portion of the remainder used for insect pests on cattle, swine, and birds (USEPA 1988b). The APHIS ADC program has not been involved in insecticidal uses. Fenthion is used in the APHIS ADC program as a dermal avicide. The compound is placed on wicked perches as a liquid or directly sprayed in lines on ledges or other specific bird perching areas. Like most organophosphates, this compound has the potential for producing secondary hazards.

(2) Use Patterns

BCF#1 (9 percent fenthion formulation) is registered for use in Hawaii under a 24(c) label for the control of the myna bird to protect human health and safety. One liter of BCF#1 was used by APHIS ADC during FY 1990. BCF#1 was applied during all four seasons in Hawaii. Rid-A-Bird 1100 perch solution contains 11 percent fenthion and 11 percent aromatic petroleum distillate. This formulation is federally registered and was used for the control of pigeons in Kentucky for human health and safety. Eight gallons of Rid-A-Bird 1100 solution were applied in FY 1989 in Kentucky for control of pigeons jeopardizing human health and safety. This formulation was used equally in Kentucky throughout the year on urban and rural private land. A total of four APHIS ADC program employees applied these two formulations. The total amount of fenthion (a.i.) used in the two States was approximately 1 gallon.

(3) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Fenthion wicked perches are applied in urban areas to control structural damage by common mynas, rock doves, starlings, and house sparrows. These formulated products have been applied in aircraft hangars at a military base and in and around farm buildings, loading docks, and bridges.

Primary Nontarget Hazards. Any birds having access to fenthion perches could be affected by use of these formulated products. Nontarget hazards are minimized by the placement of perches and the small numbers of nontarget birds likely to frequent sites in urban areas where perches are applied.

No nontarget birds were reported to be affected following application of fenthion perches in Hawaii and Kentucky. Potentially affected nontarget birds include house finches (Oldenberg, G., Personal communication, April 1992).

Secondary Nontarget Hazards. Raptors are particularly sensitive to fenthion contamination (Schafer 1984). Numerous raptors were killed as a result of secondary poisoning following fenthion spraying in Kenya to reduce damage by red-billed quelea (Bruggers et al. 1989). Spraying of fenthion is not a registered use in the United States, so secondary hazards resulting from use of wicked perches would be substantially lower. However, the possibility remains that birds receiving sublethal doses from wicked perches could fly off and be consumed by raptors or other scavengers or predators.

Domestic Animals. Domestic animals would not be affected by use of these formulations of fenthion.

Threatened and Endangered Species. The peregrine falcon is the only listed species that could potentially be affected by fenthion perches. Fenthion perches will not be placed in any location that could be used by urban peregrine falcons. Two listed species occurring in Kentucky, the bald eagle and peregrine falcon, could potentially be exposed to secondary toxicity from consuming fenthion-poisoned prey. One species in Hawaii, the Hawaiian hawk, also would be potentially affected by secondary toxicity, but use of fenthion is prohibited within the county of Hawaii to protect this species.

(4) Environmental Fate

The solubility of fenthion ranges from 54 to 56 mg/L at 20°C (USEPA 1988c). The reported soil-water partition coefficient K_d for fenthion ranges from 7.7 for sandy loam to 67.3 for high organic carbon silty clay loam (USEPA 1988c). Based on the reported K_{oc} of 1,500, (USEPA 1988c), fenthion may have moderately low mobility and is likely to sorb to soil particles and therefore is not likely to leach to groundwater.

The low persistence of fenthion in soils indicates that its residues are not likely to accumulate in soils between applications. Fenthion is reported to bioaccumulate moderately (HSDB 1991c).

Key Environmental Fate Properties. Under laboratory conditions, fenthion is fairly stable under most conditions of pH, although some degradation may occur above a pH of approximately 11. However, organophosphorus compounds such as fenthion are generally held to be relatively nonpersistent in soils (HSDB 1991c; Tinsley 1979). In fact, the tendency to degrade is one of the characteristics of organophosphates as a group (Tinsley 1979). In the environment, organophosphates are subject to hydrolysis and biodegradation. The rate of hydrolysis is influenced by the size and character of the substituents attached to the phosphorus. Thionophosphates like fenthion are in general less susceptible to hydrolysis than the corresponding phosphate esters (Tinsley 1979).

Some available data indicate that fenthion degrades fairly rapidly. Studies conducted in nonsterile silt loam with a moisture content of 75 percent and at room temperature yielded a degradation half-life of less than one day (USEPA 1988b). Fenthion is also biodegradable under anaerobic conditions; laboratory studies have indicated a half-life for anaerobic biodegradation of between three and 21 days (HSDB 1991c).

Evaluation of Off-Site Transport Potential. Although the organophosphate active ingredient is toxic to aquatic life and other nontarget species, the overriding consideration concerning environmental exposures is that the product can only be applied in a perch according to the Federal registration. When the product is used in Hawaii, it should be

applied on a layer of waterproof tape that is removed after control is obtained. The product was occasionally used in Hawaii as a hand spray within buildings (Oldenberg, G., Personal communication, April 1992). It is assumed that fenthion will remain within the perch, on the tape, or within the building, and therefore no significant off-site transport is expected.

Available data indicate that fenthion is nonpersistent and degrades fairly rapidly, with a half-life of less than a day reported in nonsterilized silt loam soil in the dark at 75 percent moisture and room temperature (USEPA 1988b). The reported data also suggest that fenthion degrades to 53 percent under anaerobic conditions after 60 days of incubation (USEPA 1988c). Fenthion and its degradation products are not likely to persist for more than a week or so in the environment. This suggests that fenthion residues within buildings will be degraded within a short time, which therefore reduces the possibility of off-site transport.

(5) Toxicology

Fenthion is relatively toxic to avian species, with LD_{50} values ranging from 2.5 to 5.94 mg/kg. Mammals are less sensitive than birds, with LD_{50} values ranging from 100 to 500 mg/kg (Schafer 1984). This compound is not selective in its toxicity and is used as a dermal toxicant. Acute dermal toxicity to birds and mammals is assumed to be two to five times higher than oral toxicity (Garrison et al. 1988). Fenthion is also chronically toxic, with a low concentration of 1 mg/kg-day established for the fetotoxic NOEL in the rabbit (USEPA 1988c). Fenthion is moderately to highly toxic to fish and highly toxic to aquatic invertebrates (Johnson and Finley 1980). Potential secondary toxicity to avian species is more likely than to mammals, based on the lower LD_{50} values for avian species.

Metabolism. The mode of action for this toxicant is cholinesterase inhibition through dermal absorption (USEPA 1988b). No baits are involved with administration of this compound to target species. Most avian species perching on the toxicant would absorb it dermally. When absorbed into the target, fenthion deposits in body fat because it is lipophilic (Menzie 1969). Excretion in warm-blooded animals is mainly through the urine (Menzie 1969).

Primary Toxicity. Fenthion is relatively toxic to avian species, with LD_{50} values ranging from 1.7 mg/kg for the redwing blackbird to 28 mg/kg for the domestic chicken. Dietary concentrations producing eight-day LD_{50} values (based on 30 ppm for bobwhite quail to 231 ppm for the mallard) are estimated at 2.7 mg/kg-d and 9.2 mg/kg-d, respectively. Mammalian toxicity is relatively lower than avian toxicity, with LD_{50}s ranging from 100 to 500 mg/kg (Schafer 1984). The acute dermal toxicity to birds and mammals can be assumed to be two to five times higher than the oral LD_{50}s (Schafer 1984). However, the dermal LD_{50} value for the mallard was sevenfold greater than the acute LD_{50} of 5.94 mg/kg (Hudson et al. 1984). The dermal LD_{50} is also slightly higher for the blackbird than the acute value (Schafer and Eschen 1984; USEPA 1988c).

Chronic toxicity from repeated exposure to fenthion is high, with a minimum lethal dose of 0.5 mg/kg-d for the mallard (Hudson et al. 1984) and 1 mg/kg-day for a fetotoxicity NOEL for the rabbit (USEPA 1988c). Data from USEPA (1988c) on mutagenicity indicate that the NOEL for mice is 10 mg/kg-d. Honey bee tests indicate high insecticidal toxicity, with a contact LD_{50} of 0.308 g/bee, consistent with others uses for fenthion as an insecticide (Farm Chemicals Handbook 1992).

Secondary Toxicity. Potential secondary toxicity to avian species is more likely than to mammals due to the greater toxicity. The potential for secondary toxicity to predatory birds was demonstrated when kestrels were fed and subsequently died from house sparrows killed by an oral dose of 10 mg/kg fenthion (USEPA 1988b). However, this study probably overestimates the secondary toxicity hazard in giving the sparrows higher doses than they would have absorbed through the feet from fenthion treated perches.

Aquatic Toxicity. Aquatic toxicity for fenthion was not addressed in detail because it was determined that due to its negligible off-site transport potential, it was not likely to create potentially hazardous exposures in the aquatic environment. It is moderately to highly toxic to fish at 0.45 to 3.2 ppm for striped bass and fathead minnows, respectively (USEPA 1988b). It is very highly toxic to aquatic invertebrates, with daphnids apparently the most sensitive at 0.62 ppb LC_{50} (Johnson and Finley 1980; USEPA 1988b). Field tests have shown that when fenthion is applied directly to water at a rate of 0.1 pound a.i./acre, amphipods and isopods could be killed. Johnson and Finley (1980) report that the cumulative toxicity index is 2.5, which does not indicate cumulative toxicity to aquatic organisms.

Benchmark Value. Based on the high dermal and secondary toxicity of fenthion to birds, a thorough analysis was warranted for the QRA. Benchmark values were determined for two indicator avian species, identified in the Exposure Assessment section, including a passerine for dermal exposure and a raptor for secondary exposures, both acute and chronic. No aquatic receptors were assessed based on minimal off-site transport. Surrogate species were then selected based on the available toxicology and similar physiology to the indicator. The benchmarks derived are listed in Table P-23. Because of the highly toxic nature of fenthion, acute toxicity is the most representative, although chronic toxicity was also investigated. Acute and subchronic dermal toxicology studies were available for the house finch using the house finch itself and the bobwhite quail, respectively. Uncertainty for the acute house finch benchmark was low because of lack of interspecies variability. The subchronic lethality endpoint for the chronic study of the quail results in a higher UF (subchronic to chronic). Acute studies for the American kestrel were available; no surrogate was necessary.

The cumulative UF value for protecting the house finch from acute hazards was determined to be 6 because the surrogate and indicator were identical. This resulted in a benchmark value of 1.67 mg/kg. The chronic benchmark necessitated an additional factor of 25 (final UF of 150) because of the interspecies and endpoint extrapolation to produce a benchmark of 0.02 mg/kg-d. The cumulative UF for protecting the kestrel from acute toxicity from secondary poisoning was 20, deriving a final benchmark of 0.05 mg/kg-d. The chronic benchmark was determined to be 0.02 (UF of 50). No aquatic surrogate was necessary due to limited off-site transport potential.

(6) Screening

Both formulations of the dermal toxicant fenthion have been determined to warrant a quantitative risk assessment. The cumulative score for analysis of both formulations was 62. The scores would not change significantly if the formulations were evaluated separately. These scores were supported by both the exposure component, particularly to threatened and endangered species (23), and the acute and chronic toxicity of fenthion (26).

(7) Exposure Assessment

Indicator Species and Exposure. The house finch was selected as the indicator species to address primary exposures associated with fenthion. This species occurs year-round in Kentucky and is likely to perch in rural areas treated with fenthion perches.

The American kestrel was selected as the indicator species for secondary toxicity of fenthion because its habitat use, distribution, and diet promote the likelihood of exposure to fenthion. No observations of secondary hazards to kestrels or other raptors have been reported as a result of use of fenthion perches. Secondary hazards are apparent during toxicological studies; for example, several kestrels died after they were fed fenthion-poisoned house sparrows (USEPA 1988b).

Exposure Factors. Exposure factors for the house finch basically include the body weight and the area of the feet, which are assumed to be exposed to the pesticide via contact with the perch. The body weight ranges around 22 g. The area of the feet was assumed to be 5 cm^2, an unmeasured conservative estimate. These factors were calculated differently in Table P-22 to derive a final daily intake of the pesticide. The American kestrel exposure factors were delineated for 4-aminopyridine and only varies based on the prey concentration. The percentage of range of the kestrel also varies with compound, depending on the extent of application.

(8) Risk Characterization

Primary. Results addressing acute nontarget dermal exposure to the house finch indicate that the chemical control method is highly toxic. The calculated HQ value of more than 100,000 was based on this dermal pathway, based on exposures to 11 percent fenthion in solution. The acute dermal benchmark value, which indicated high toxicity, contributed significantly to the highly elevated value. Calculations for dermal exposure are assumed to be conservative, representative of most avian species, and in agreement with fenthion toxicity literature. Similar hazards are expected with the 9 percent solution because the same indicator species is applicable for the state where the formulation was used.

Exposure factors supporting the above calculations again contributed significantly to elevated HQ values. For example, the calculation assumes that the house finch is present at the site of application at all times and sits on the perches for 6 hours per day. The limited home range of the finch (approximately 0.8 acre) also contributes to the elevated exposures. The major factors contributing to elevated exposures, however, are the high concentrations and levels of toxicity. No soil pathway was assumed for the primary dermal exposure to the finch.

Secondary. The results for secondary exposures of fenthion to the American kestrel suggest little potential hazard based on consuming contaminated dead birds, with acute and chronic HQ values of 0.11 and 0.28, respectively. This is explained by the very low dose ingested by the kestrel per prey organism, because small amounts of the material are lethal to the prey organism. Results also indicate that chronic toxicity is of greater concern than acute, based primarily on the smaller (more toxic) chronic benchmark value. The maximum tissue concentration used was based on the dermal LD_{50} of the starling.

The contribution from the soil pathway to potential secondary exposures to the kestrel is relatively insignificant, with a corresponding HQ of less than 0.01 for both acute and chronic exposures.

Based on the results of the quantitative risk assessment for the American kestrel, secondary hazards are unlikely to occur for other species of predators and scavengers, including listed species (bald eagle and peregrine falcon) consuming fenthion-poisoned prey.

Aquatic. No aquatic receptors were calculated based on the minimal offsite transport potential and on the basis of the use patterns detailed above.

(9) Conclusions

Primary Toxicity. This formulation may potentially affect the house finch, based on both acute and chronic dermal exposures calculated almost exclusively on expected concentration (dose) of the liquid formulation. It could potentially affect other nontarget birds likely to occur in urban areas where fenthion perches are used. Fenthion perches are not to be used where there is any potential contact with urban peregrine falcons.

Secondary Toxicity. No probable risk is expected, based on low concentrations of prey ingested, resulting in a low hazard quotient for the indicator species (American kestrel) and thus to the listed species (peregrine falcon and bald eagle).

Aquatic. No probable risk is expected, based on minimal offsite transport potential, because fenthion is used exclusively on perches and ledges.

(10) Comparison of Findings with Those of USFWS and USEPA

These formulated products were not considered in USFWS's Biological Opinions.

USEPA concluded that use of fenthion as an avicide would result in risks for any listed bird species having access to fenthion perches (USEPA 1991b). The risk assessment concluded that no listed species would be at risk because none are likely to occur in urban areas within the range of use of fenthion perches.

USEPA further concluded that a "may affect" situation exists for any carrion-feeding birds and mammals occurring in areas where fenthion perches are being used (USEPA 1991b). This differs from the risk assessment conclusion that no risk would be posed to listed raptors, based on relatively low estimated concentrations of fenthion in ingested prey and a low hazard quotient for the indicator species (American kestrel). It is noted that secondary hazards for raptors exposed to fenthion have been reported in the literature.

USEPA concluded "no effect" for fenthion perches, which is consistent with the conclusion of the risk assessment of no probable risk based on minimal off-site transport potential because the compound is used exclusively on perches and ledges.

(11) Mitigation

No mitigation is required for these fenthion formulations.

m. Mineral Oil: Petroleum Distillates

(1) General Discussion

Mineral oil, a petroleum product, could be considered highly lipophilic and can bioaccumulate in tissue. Mineral oil is used for the control of gulls for the protection of buildings, landscaping, and human health and safety. Spraying gull eggs with mineral oil prevents hatching of gull eggs through physical effects (asphyxiation) to the embryos. Fifteen gallons of mineral oil were applied in Washington State in 1988 on rural, public land by a total of three APHIS ADC program employees. The method is used primarily during the spring, when eggs are laid. Nontarget animals are not affected by use of mineral oil because it is nontoxic to hatched birds.

The mode of action for this end-use formulation is to suffocate bird eggs in their nests. Based on limited documented studies, toxicity of mineral oil to birds and mammals is minimal. LD_{50} values for rodents, primates, and starlings are all greater than 1,000 mg/kg, according to Schafer (1991a). Mineral oil is commonly used and ingested by humans. No mortalities of nontarget species occurred, based on the limited studies (Christens and Blokpoel 1991). Primarily due to the low acute toxicity and mode of action, it can be assumed that there is no secondary toxicity hazards.

(2) Critical Element Screening

Based on the above discussion, there is very little likelihood that this product could contribute to nontarget effects. Accordingly, they were eliminated from further consideration, based on the risk assessment scoring criteria summarized below.

(3) Documentation of Results

Primary Toxicity. No probable risk, based on critical element screening, because the formulated product is not toxic and no nontarget animals are exposed.

Secondary Toxicity. No probable risk, because compound is not toxic and no nontarget animals are exposed.

Aquatic. No probable risk because of low degree of toxicity.

n. Glyphosate (Rodeo), 53.8 percent — $C_3H_8O_4PN$; CAS # 38641-94-0

(1) General Discussion

This compound is an post-emergent, nonselective herbicide registered for use in aquatic environments. The active ingredient is isopropylamine salt of N-phosphonomethyl glycine. The herbicide is used by APHIS ADC to control cattails where blackbirds roost.

(2) Screening

(a) Use Patterns

The herbicide glyphosate, in the formulation registered as Rodeo, was applied in North Dakota and South Dakota between FY 1988 and FY 1991. It was applied to cattails to eliminate roosting habitats for blackbirds, thus reducing damage to sunflower fields. The formulation of Rodeo contains 53.5 percent glyphosate. More than 560 gal of Rodeo (303 gallon a.i.) was used by APHIS ADC in North Dakota. Approximately three APHIS ADC program employees applied this formulation to rural cattail plots in these two States. The maximum application rate used was 12.4 pounds (6.7 pounds a.i.) per acre of treated site. The product is used during the summer, when cattails are most vulnerable to the herbicide.

(b) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Glyphosate is sprayed on dense cattails in marshes to eliminate roosting habitats for blackbirds. The herbicide is used to control blackbird damage to sunflower fields.

Primary Nontarget Hazards. No animals would be directly affected by use of glyphosate. Manipulation of wetland vegetation does result in habitat loss for other wetland-dependent bird species. Application of glyphosate in North Dakota to reduce damage by blackbirds resulted in a significant decrease in numbers of marsh wrens, soras, and Virginia rails because these birds required dense emergent vegetation for foraging and nesting (Linz et al. 1992). Numbers of ducks and shorebirds did not significantly differ between glyphosate-treated and untreated marshes (Linz et al. 1992). Use of herbicides should improve habitat for waterfowl because marshes with dense stands of tall emergents generally are used less by waterfowl than marshes with interspersions of open water and emergent vegetation (Linz et al. 1992).

Secondary Nontarget Hazards. No secondary hazards would result from the use of glyphosate.

Domestic Animals. No domestic animals would be affected by use of glyphosate.

Threatened and Endangered Species. No threatened or endangered species occurring in North Dakota or South Dakota would be affected by use of glyphosate.

(c) Environmental Fate

Glyphosate salts are readily soluble in water, with a solubility of 12 g/L. The K_{oc} for glyphosate is 10,000 cc/g (USEPA 1989h). The high K_{oc} indicates that glyphosate is readily sorbed to soils and that the mobility of glyphosate may be very low. The soil degradation half-life (30 days) for glyphosate indicates that it has moderately low persistence. Data indicate that degradation occurs in water, and 50 percent of the glyphosate is lost within 60 days in soils (HSDB 1991e). This indicates that glyphosate is moderately persistent. Glyphosate translocates readily into foliage, accounting for its effectiveness as an herbicide. Because of its low mobility and moderate persistence, glyphosate may accumulate in soils between applications. Limitations on application rate and frequency would minimize the accumulation of glyphosate residues. Glyphosate is not expected to bioaccumulate in plant and animal tissues.

(d) Toxicology

This herbicide is virtually nontoxic to birds and mammals. Acute toxicity to rats was greater via the intraperitoneal (i.p.) route than when orally administered, with a LD_{50} of 235 mg/kg and 4,873 mg/kg, respectively (USEPA 1991n). This trend is also demonstrated in the mouse, with i.p and oral LD_{50}s of 130 mg/kg and 1,568 mg/kg, respectively. The difference in toxicity of the two modes of administration indicates that glyphosate is not readily absorbed in the gastrointestinal tract. A chronic one-year study on deer mice using Rodeo indicated no apparent adverse effect on reproduction, growth, or survival after one year of label-specified field treatment in a forest (HSDB 1991e). A 2-year feeding study on dogs, rats, and mice indicated that at levels as high as 500 mg/kg-d, there were no observed effects (USDA 1988). A chronic feeding study on heifers with a diet of 540 mg/kg-day yielded no observable effects (Rodeo label).

Due to its low acute toxicity and mode of action, Rodeo (glyphosate) is assumed to pose no secondary toxicity hazards. Therefore, little hazard is present to predators of affected fish because of this low secondary toxicity.

Fathead minnows exhibited the lowest 96-hr LC_{50} of 97 mg/L, with rainbow trout, bluegill, and channel catfish exhibiting LC_{50}s above 130 mg/L for the technical grade material (96.7 percent) in one source (HSDB 1991e). However, data from the Johnson and Finley (1980) study revealed that the Roundup formulation (41 percent a.i.) was three to 42 times more toxic to aquatic organisms than the technical grade material. Additionally, it was found that toxicity increases with increasing temperature (e.g., would be twice as toxic to rainbow trout at 17°C as at 7°C).

(3) Documentation of Results

This herbicide was screened out based on low scores for all of the screening components. The intended use of this chemical method is to manipulate habitat of the target species. The only nontarget concern was loss of habitat for other wetland birds. The highest score was for the use pattern (8) because of the quantity of compound used. The use pattern was given less weight than nontarget receptors and toxicology, indicating that there is little potential for hazards resulting from use of this herbicide. The total score of 27 was well below the threshold value of 35, so glyphosate was determined to be present no probable risk.

Primary Toxicity: No probable risk, based on the screening score, because the product and its use does not result in death of these animals. No probable risk to listed species or critical habitat for listed species in the States where this product was used.

Secondary Toxicity. No probable risk because glyphosate is relatively nontoxic.

Aquatic. No probable risk because glyphosate is slightly toxic to aquatic species.

o. Compound PA-14 (Tergitol), 99.5 percent CAS # 68131-40-8

(1) General Discussion

Compound PA-14 is a surfactant or wetting agent that decreases the insulating ability of birds' feathers, causing hypothermia and death. The wetting agent is applied at night to target birds that are concentrated in roosts, where large numbers of birds can be affected by aa single treatment. To be efficacious in killing the birds, PA-14 applications must be accompanied by cold and wet conditions.

Aircraft have been used to apply PA-14 prior to expected rainfall, but because weather forecasts are not always accurate, ground-based systems that apply PA-14 with copious amounts of water are more dependable. All PA-14 applications by the APHIS ADC program during FY 1988 were made with ground-based spray systems.

PA-14 has not been used by the APHIS ADC program since 1989, and the USEPA registration was canceled in 1992.

(2) Screening

(a) Use Patterns

This formulation contains 99.5 percent active ingredient, a nonionic surface-active agent (surfactant). The product is a restricted use pesticide used by APHIS ADC to control damage by blackbirds, and it is also used against starlings for human health and safety and protecting property and natural resources. The surfactant was applied by 11 APHIS ADC program employees and 24 other workers as a spray to large blackbird roost sites in FY 1988. A total of 715 gallons of product was used in three States (KY, MS, TN) on both urban and rural private land. The product is applied only during winter, when cold weather increases the likelihood of hypothermia and death of the target species.

(b) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. PA-14 is aerially applied to winter roost sites (groves of trees or other dense vegetation) used by large numbers of blackbirds and starlings. Winter roost sites selected for treatment are typically in upland areas away from surface water.

Primary Nontarget Hazards. All avian species in the roost at the time of application could be affected by use of PA-14. Nontarget deaths recorded from past applications of PA-14 include more than 2,700 American robins, eight northern cardinals, five northern bobwhites, two dark-eyed juncos, one song sparrow, and one white-throated sparrow (Hardy et al. 1971 in USFWS 1976b; Heisterberg et al. 1987).

Secondary Nontarget Hazards. No known instances of secondary poisoning have occurred resulting from use of PA-14. Based on LD_{50} values, no secondary toxicity hazards are expected even if a scavenging animal were to eat a considerable number of bird carcasses (USFWS 1976b).

Domestic Animals. No domestic animals would be affected by application of PA-14.

Threatened and Endangered Species. No threatened or endangered species occurring in the areas of use (KY, MS, TN) are likely to be affected by use of PA-14.

(c) Environmental Fate

Compound PA-14 is nonionic and is stable in acidic, neutral, or alkaline media (USFWS 1976b). Based on its reported high water solubility, PA-14 is expected to be moderately highly mobile in soils. However, one biodegradability study indicates that PA-14 tends to adhere to organic and bacterial soil particles, but not to inorganic soil particles (USFWS 1976b). Therefore, the overall mobility of PA-14 in soils is expected to be moderate.

PA-14 was found to be efficiently biodegraded under a range of environmental conditions (Conway and Waggy 1966). The half-life of PA-14 in water is reported to be less than 4 days (USFWS 1976b). One soil study showed that no PA-14 was detected in soils 7 months after application at Fort Campbell, KY (U.S. Dept. of the Army 1975). Based on the balance of evidence, the persistence of PA-14 in soils is expected to be low.

When an aerial application of PA-14 is made, only a fraction of the solution falls immediately earthward; a portion of the solution changes phase from liquid to gas by evaporation, and another portion remains temporarily in the air as a residual mist. The portion of PA-14 remaining in the air may slowly settle to the earth under the influence of gravity and can be transported by winds to outside the vicinity of the application target. However, a number of studies have shown that the residual PA-14 mist is not present in sufficient quantities to pose a significant hazard to humans (USFWS 1976b).

PA-14 residue is not expected to accumulate between applications because of its low persistence and moderate mobility. The bioaccumulation of PA-14 in plant and animal tissue is not likely, since PA-14 is efficiently biodegraded.

(d) Toxicology

This compound is a nontoxic soporific, and its mode of action is through the breakdown of natural oils in the feathers of target birds, removing natural waterproofing properties. When this breakdown of oils is accompanied by sufficient moisture, the result is a reduced body temperature and eventual death through hypothermia. PA-14 is slightly toxic to birds and mammals, with LD_{50}s ranging from 900 to 2,000 mg/kg (Schafer 1984). Because of its low acute toxicity, it can be assumed that it is also not chronically toxic to animals. Direct contact of humans with PA-14 causes slight skin irritation and serious eye damage. No known instances of secondary toxicity have occurred with PA-14. Secondary toxicity is not likely to occur because of the low acute toxicity of the compound and the indirect cause of death of the target species.

PA-14 is intended to degrade and be nonpersistent in the aquatic environment, but it is toxic to crustaceans, insects, snails, and clams at less than 10 mg/L under test conditions, as documented by Marking and Chandler (1981). For this reason, the label restricts use to areas with no surface water. Toxicity to aquatic organisms was increased in some species with increased water temperature. This formulated product is generally not very toxic.

(3) Documentation of Results

This product was determined to pose no probable risk based primarily on the low avian and mammalian toxicity. The product is not specifically used as a toxicant, although it is a lethal stressing agent, causing death through environmental effects, indicating a lower hazard potential based on direct toxicity. The score based on toxicology, three (3), was very low compared to the highest toxicity score of 27 for fenthion. The final score of 26 was also supported by the lack of hazards to threatened or endangered species.

Primary Toxicity. No probable risk expected because of the low toxicity and lack of hazards to listed species. Use of this formulated product may kill some birds occurring in association with roosting blackbirds, including robins, cardinals, and sparrows. No probable risk expected for listed species because none occurring where PA-14 is used are likely to co-occur with blackbirds in roosts.

Secondary Toxicity. No probable risk expected, based on low primary toxicity.

Aquatic. No probable risk expected, based on restricted use pattern.

p. Polybutene (Eaton's 4-the-Birds), 80 percent CAS # 9003-29-6

(1) General Discussion

Eaton's 4-the-Birds is a transparent, sticky compound that, when applied to ledges and sills, will discourage birds from roosting or perching on these areas. The product contains 80 percent polybutene and was used for the control of pigeons in Hawaii to protect equipment, and human health and safety. A total of 50.4 ounces of this commercially available product was used by approximately six APHIS ADC program employees in 1990. Eaton's 4-the-Birds was used equally year-round in urban locations in Hawaii in FY 1990-91. Use of this compound does not result in death of any target or nontarget animals due to the lack of toxicity.

(2) Critical Element Screening

Based on the above discussion, there is very little likelihood that this product could contribute to nontarget effects, because of negligible toxicity. Accordingly, this product was eliminated from further consideration based on the criteria summarized below.

(3) Documentation of Results

Primary Toxicity. No probable risk expected, based on critical element screening, because the formulated product is not toxic.

Secondary Toxicity. No probable risk expected because the formulated product is not toxic.

Aquatic. No probable risk expected because the formulated product is not toxic.

q. Strychnine — $C_{21}H_{22}N_2O_2$; CAS #57-24-9

(1) General Discussion

Strychnine has been used throughout the world for controlling vertebrate pests for many years. In the United States, it was widely used in rodenticidal, predacidal, and avicidal applications before 1972, when predacidal uses were banned, canceled, and suspended by USEPA. All remaining aboveground uses were suspended in 1988. Since then, strychnine has been available only for placement underground in rodent burrows and runways. The risk assessment addresses all strychnine-based products used above- or belowground during any of the four target years (FY 1988-91). Above-ground uses occurred in FY 1988 prior to USEPA's suspension of such uses.

The APHIS ADC program maintains six FIFRA Section 3 registrations for strychnine products, the labels for which are shown in Appendix Q. Many state and local (FIFRA Section 24c) registrations are also maintained. Most strychnine products used by APHIS ADC field personnel are ready-to-use grain baits containing 0.35 to 0.60 percent active ingredient. Other formulations include strychnine pastes, that are mixed in the field with various types of food baits prior to application, and salt blocks (see Table P-7).

In FY 1988, APHIS ADC personnel used strychnine mostly in grain baits applied to pastures, rangelands, or field borders to kill burrowing rodents (gophers, prairie dogs, and ground squirrels) that damaged range vegetation, forage, or food crops. Small amounts also were used to reduce pigeon populations that caused human health or safety problems. Since 1988, APHIS ADC program use of strychnine has been limited mostly to underground applications for the control of damage caused by gophers in range, pasture, and forest environments.

Strychnine can be used only by State-certified pesticide applicators. A total of 25 APHIS ADC program employees used one or more strychnine products in six western States and Louisiana in direct control activities during FY 1988-91 (Table P-7). Maximum annual use of all formulations during these years totaled 46 pounds of active ingredient. Strychnine products were used at all times of year. Over 95 percent of APHIS ADC program use of strychnine during FY 1988-91 occurred on private lands; the remainder was on public land, primarily rural school lands in Nebraska.

(2) Environmental Fate

The water solubility of strychnine is 160 mg/L. An estimated K_{oc} value of 267 suggests that strychnine would have moderate mobility in soils (HSDB 1991j; Lyman et al. 1990). However, strychnine is a basic compound ($pK_{a1} = 6.0$; $pK_{a2} = 11.7$ (HSDB 1991j)) and will exist primarily in the ionized form under average environmental conditions. Adsorption characteristics of ionic compounds can vary significantly from those of neutral compounds. Therefore, the ability of strychnine to adsorb to soils cannot be predicted with certainty since this compound may act markedly differently than its estimated K_{oc} value would indicate (HSDB 1991j). This fact is confirmed by a soil study showing strychnine to be relatively immobile in soil systems, particularly in soils with moderate to high cation exchange capacities, and it is not expected to leach rapidly (Miller et al. 1983). As a result of the laboratory study, a moderately low mobility of strychnine in soils was assumed for screening purposes.

Strychnine is both photodegradable and biodegradable. The absorption maximum for ultraviolet light occurs at 289 nm. Ultraviolet absorption then drops off between 290 and 300 nm, with a relatively weak secondary absorption peak at above 300 nm (HSDB 1991j). The soil biodegradation half-lives under aerobic and anaerobic conditions were estimated to be seven to 28 days and 28 to 112 days, respectively (Howard et al. 1991). Strychnine has the potential to photolyze on soil surfaces and in water systems. This information indicates that strychnine may have moderately low persistence.

Strychnine is also not expected to accumulate in soils between applications based on this low persistence. Bioaccumulation of strychnine in plant and animal tissue is also expected to be low. Following ingestion, strychnine is rapidly detoxified and excreted (Savarie 1991).

Due to its low vapor pressure, strychnine is not likely to be present in the air except as a particulate. Removal from the air would likely occur through photolysis or dry deposition. Chemical hydrolysis of strychnine is also not likely to occur at neutral pH, based on its chemical structure. The most readily hydrolyzed strychnine substituent is an amide functional group. However, half-lives for amides at pH 7 and 25°C are on the order of years (HSDB 1991j).

Evaluation of Off-Site Transport Potential. All aboveground uses of the product were temporarily canceled by the USEPA in September 1988 (USEPA 1988d). This temporary cancellation remains in effect as of January 1994. In this risk assessment, all aboveground formulations were evaluated together based on 1988 applications for control of pigeons, sparrows, and rodents. Thus, although different formulations are involved, this analysis was conducted on the basis of all aboveground products; it was not necessary to consider each formulation individually. Off-site transport through runoff and erosion could occur while baits are still present, because strychnine is partially soluble (160 mg/L) and the soil adsorption coefficient is relatively low (K_{oc} = 267) (HSDB 1991j, USEPA 1989g). Because the material is highly toxic to aquatic life, aquatic effects could potentially occur if a receiving water body adjoins baited areas. In addition, nontarget birds or mammals could be affected because of the broad-spectrum toxicological properties of the active ingredient.

Based on the estimated K_{oc}, strychnine is moderately mobile and could migrate to groundwater, although laboratory studies indicate the opposite, particularly in soils with moderate to high cation exchange capacities (Miller et al. 1983). Furthermore, the rapid soil degradation indicates that this compound is not persistent, and as a result, migration to groundwater is unlikely.

Below ground strychnine products (two formulations) are less likely to be transported off-site because all are contained within rodent burrows and sheltered from water and sunlight degradation. The only exception involves the use of automated burrow-builders, where incidental above ground spillage could occur. When care is taken to avoid or clean up such spillage, it does not result in hazardous levels of above ground exposure. off-site transport will therefore not be quantified for the below ground strychnine formulations. These two formulations will be considered together in later analysis.

(3) Toxicology

Strychnine is well known for its highly toxic effects on birds and mammals. Table P-11 tabulates the data, species, and sources of the toxicity information used in this evaluation.

Metabolism. Metabolism of strychnine in some species is an enzymatic mechanism occurring in the liver. Pathological changes occur primarily in the liver and kidney, which are involved with detoxification and excretion. Twenty to 50 percent of strychnine doses appear to be readily excreted from a variety of animals (Gilman et al. 1985 in HSDB 1991j). Little potential for accumulation is indicated, and the compound is completely detoxified within the first 24 hours after administration (USEPA 1980). Although

strychnine decomposes in the body while the animal is still alive, it resists decomposition for long periods after death within the gut and could be available to nontarget predators or scavengers (Copeman 1957).

Primary Toxicity. Gallinaceous birds and some species of waterfowl generally are not vulnerable to strychnine poisoning from baits used in rodent and avian control. Seed-eating birds, however, are very susceptible. Strychnine is highly toxic to humans through inhalation of the technical powder, with a threshold limit of 0.15 mg/m^3 (Sax and Lewis, 1987). The range of LD_{50} values for birds is from 3.1 mg/kg for the mallard to 112 mg/kg for the California quail, with most values less than 10 mg/kg. Toxicity to gallinaceous birds appears to be lower, with values for the quail, turkey, ring-necked pheasant, and sage grouse above 20 mg/kg. Toxicity to mammals is higher, with values below 1 mg/kg for the coyote, desert kit fox, ferret, and mink, as listed on Table P-11. The toxicity to grizzly bears was assumed to be the lowest dose causing mortality to mammals (minimum lethal dose of desert kit fox at 0.33 mg/kg).

Many insects have been shown to be unaffected by strychnine, with the compound passing unchanged through the digestive tract of beetles (USDA bibliography, no date). Strychnine administered orally to ants (0.1 - 0.5 mg/kg) produced disturbed motor coordination but no mortality (Kostowski et al. 1965).

Chronic toxicity of strychnine has been studied extensively. Sublethal amounts of strychnine are completely eliminated from the body. An USEPA-approved GLP study used five groups of five mallards for a 28-day dietary toxicity with a NOEL considered to be 75 ppm, ranging from 78 to 140 grams/bird-day (Pedersen and Helsten 1992b). Based on the percent of body weight eaten per day (4 percent for mallard as cited in Kenaga 1973), the actual dose was 3 mg/kg-d, which is suggestive of chronic toxicity. A similar 28-day chronic dietary toxicity study was conducted on bobwhite quail, with a no-effect level occurring at 1,000 ppm (estimated to represent 90 mg/kg-d). Consumption ranged from 14 to 19 grams/bird-day (Pedersen and Helsten 1992a).

Secondary Toxicity. The presence of strychnine in the gastrointestinal tract of poisoned animals has been shown to produce secondary toxicity to predators and scavengers (USEPA 1980). Secondary poisoning is more likely for carrion-eating mammals than raptors, which generally eviscerate prey and remove the poisoned gastrointestinal tract prior to ingestion (USEPA 1980). Because strychnine is a rapid-acting poison but is not absorbed quickly, undigested poison frequently remains in the gastrointestinal tracts of poisoned animals (Colvin 1984; Hegdal and Gatz 1977a; Redig et al. 1982). As stated previously, toxic amounts of strychnine may remain in animal carcasses for long periods after death. Secondary toxicity in the field, however, may be infrequent because coyotes have been observed to reject portions of the gastrointestinal tract, possibly due to the bitter taste of strychnine (Marsh et al. 1987; Schmatz et al. 1989; Anthony et al. 1984).

Aquatic Toxicity. LC_{50} values for the bluegill and inland silverside are 0.87 mg/L and 0.95 mg/L, respectively, indicating that strychnine is toxic to aquatic species (Dawson et al. 1977). A study on the acute toxicity of strychnine to water fleas resulted in a 48-hour EC_{50} of 11 mg/L, with an estimated NOEC of 1.7 mg/L (Forbis 1989). The median threshold limit (MTL) for exposure to aquatic species (0.1 to 1 mg/L) was established by USEPA in its Integrated Risk Information System (USEPA 1991k).

Benchmark Values. Based on the highly toxic nature of strychnine to both birds and mammals, the pesticide was analyzed in the QRA. Benchmarks were determined for five indicator species, including one passerine, a raptor, a rodent, a carnivorous mammal, and fish (Table P-23). Surrogate species were then selected based on the available toxicology and similar physiology to the indicators. Both acute and chronic benchmarks were derived and listed in Table P-23. The raptor and the carnivorous mammals were assumed to be exposed through secondary toxicity.

A study of acute toxicity to the sparrow was used to represent acute exposures to the horned lark and eastern meadowlark, indicator avian species, with a cumulative UF of 45 used to derive the final benchmark of 0.09 mg/kg. A chronic mallard study was used for chronic effects to the larks. The mallard is a common waterfowl species used in toxicity testing, but generally is not the most sensitive species. The mallard apparently is more sensitive than the bobwhite quail, another commonly studied species (Pedersen and Helsten 1992a; 1992b). The chronic endpoint found for the mallard is therefore very sensitive and assumed to be most representative of potential chronic avian toxicity. The UF used was 14, less than the acute study because of the sensitivity of the chronic endpoint and the reliability of the study. The final benchmark value for chronic toxicity to the larks was 0.63 mg/kg-d. The golden eagle was selected as a surrogate species for estimating secondary hazards to raptors, using the American kestrel as the indicator. A cumulative UF of 60 was used to extrapolate to an acute benchmark of 0.08 mg/kg. The chronic benchmark was assigned a UF value of 15, thus yielding a final value of 0.03 mg/kg-d for the kestrel.

The deer mouse was represented by a rat study for computation of acute and chronic benchmark values. An LD_{50} study was used and a UF of 90 was calculated, yielding an acute benchmark of 0.04 mg/kg-d. The chronic benchmark was determined to be 0.21, using a small uncertainty factor of 12, based on the high quality of the study and the sensitive endpoint (LOEL).

Toxicity data were available for the coyote, so a surrogate was not needed for this species. The acute value for the coyote was lower than the chronic value. The acute benchmark value was determined to be 0.07 mg/kg, derived using a UF of 10. The chronic endpoint used, a NOEL, was very sensitive and resulted in a small UF. The final benchmark value was calculated to be 0.72 mg/kg-d (UF of 2) for chronic exposures.

The surrogate species for freshwater fish was the most sensitive aquatic species found, bluegill. A UF value of four (4) was assigned because of the high sensitivity of the chronic no-effect endpoint. The benchmark for freshwater fish was determined to be 0.08 mg/L.

r. Strychnine (Pigeon Bait Strychnine Corn, 0.4 percent; Sparrow-cracks, 0.6 percent; and Bird Toxicant, 0.35 percent)

(1) Use Pattern

These three grain bait formulations were used for the control of pigeons, sparrows, grackles, and blackbirds to reduce damage to crops, equipment, property, and human health and safety. The pigeon bait is federally registered for use by the APHIS ADC program. The other two formulations are commercially available and federally registered through other manufacturers. All three are restricted use pesticides and were only applied to private land. All three labels require that uneaten bait and remaining carcasses be removed at the end of the day. Approximately four to six APHIS ADC program employees used these three formulations in the two States. Strychnine pigeon bait was used in Louisiana and Texas at a formulation of 0.4 percent a.i. and a maximum application rate of five quarts per site. Strychnine sparrow-cracks and bird toxicant were used in Texas with concentrations varying from 0.35 percent to 0.6 percent a.i. The maximum use of any of these formulations was 40 pounds in Texas, containing only 0.16 pound of active ingredient. The formulations were used throughout the year, but primarily in the winter and spring.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Strychnine pigeon bait was applied in urban areas, particularly on building rooftops and in aircraft hangars, to reduce structural damage by feral pigeons. Strychnine Sparrow-cracks were applied in and around farm buildings to control damage by

house sparrows. Strychnine bird toxicant was applied in cattle pens to control damage by grackles and blackbirds to citrus and crop production areas in the Rio Grande Valley (Hobbs, J., Personal communication, May 1992).

Primary Nontarget Hazards. Any bird or mammal likely to ingest bait could be affected by application of these formulated products. The number of nontarget species that could be affected is limited to species likely to consume baits applied in and around buildings or in cattle pens. Reported nontarget deaths include one meadowlark and one red-winged blackbird in Louisiana (USFWS 1992) and five mallards and three brown-headed cowbirds in metropolitan areas of Minnesota (Redig et al. 1982).

Other potential nontarget animals that are likely to consume strychnine avicide baits applied in and around buildings and in cattle pens include ring-billed gulls, ring-necked pheasants, mourning doves, northern flickers, blue jays, American crows, northern cardinals, common grackles, house sparrows, eastern fox squirrels, deer mice, and commensal rodents.

Secondary Nontarget Hazards. Strychnine avicide baits pose a significant secondary hazard to predators and scavengers. Pigeons poisoned with strychnine die within five to 20 minutes. Undigested bait in the crop or gut of a pigeon or other affected bird can easily contain enough strychnine to kill any dog, raptor, cat, or other scavenging animal that consumes the undigested bait (Cleary 1984).

Reported nontarget species killed by secondary toxicity resulting from consumption of strychnine pigeon bait include one herring gull, one great horned owl, and three snowy owls in Duluth, MN (Redig et al. 1982) and one great black-backed gull in Boston, Massachusetts (Faulkner 1964 in USEPA no date). Other scavengers and predators potentially susceptible to secondary toxicity from application of these products include the turkey vulture, black vulture, sharp-shinned hawk, red-tailed hawk, peregrine falcon, barn owl, opossum, and coyote.

Domestic Animals. Domestic livestock would not be affected by application of strychnine bird toxicant in cattle pens because livestock are excluded from the area before baiting (Hobbs, J., Personal communication, May 1992). Domestic pets are susceptible to secondary toxicity resulting from application of strychnine avicides. One domestic dog was found dead following a pigeon control operation in Boston, MA (Faulkner 1964 in USEPA unpubl. report).

Threatened and Endangered Species. Two listed species occurring in Texas, the Attwater's greater prairie chicken and whooping crane, would potentially be affected from consuming strychnine avicide baits. Five listed species, the bald eagle, northern aplomado falcon, jaguarundi, ocelot, and Louisiana black bear, would potentially be affected by secondary toxicity from consuming prey poisoned by strychnine avicides. Use of strychnine avicide baits is not specifically restricted within the range of these two species.

The peregrine falcon, an endangered species, has been adversely affected by use of strychnine avicides for control of pigeons. Between 1980 and 1983, necropsies on five peregrine falcon carcasses showed the presence of strychnine in the gastrointestinal tracts as well as hemorrhages in the oral cavities, brains, and lungs (USFWS 1988a). At least four of these deaths were in urban areas, and there is strong evidence that the strychnine received was a result of pigeon control (USFWS 1988a). Current label restrictions for strychnine corn pigeon bait protect the peregrine falcon by specifically prohibiting use of the formulated product within five miles of aeries or critical habitats or when migratory falcons may be present. No restrictions to protect the peregrine falcon are listed on the labels for strychnine bird toxicant or sparrow-cracks.

(3) Screening

The three avicidal formulations of strychnine scored 58, 58, and 57, respectively, indicating that all three products would warrant QRA. These scores were primarily supported by the presence of potentially exposed threatened and endangered species in the two States where these formulations were applied (Texas and Louisiana). The score for biological considerations for all three end-use formulation was 27. Strychnine is also highly toxic to many species and thus received a score of 21 (based on the active ingredient only) for toxicity.

(4) Exposure Assessment

Indicator Species and Exposure. The eastern meadowlark and American kestrel were the indicator species selected to represent primary and secondary exposures from the use of these avian formulations. The meadowlark is common in the States that used the three avicides. The life history has been described in the discussion of Avitrol 0.5 percent. The exposure factors are the same except bait concentration. The kestrel has also been described for the Avitrol formulation with similar parameters other than the final prey concentration ingested. Benchmarks were determined for these species.

(5) Risk Characterization

Primary. Results for the eastern meadowlark, presented in Table P-27, suggest evidence of highly toxic acute exposures, based on ingestion of strychnine avicide formulations ranging from 0.35 percent to 0.6 percent a.i. The acute hazard is supported by an acute HQ value of 3,200. Toxic chronic exposures, also are expected based on the HQ of 384, which was significantly less than the acute HQ value, thus indicating lower chronic toxicity. These elevated values are based primarily on the high concentration of the bait used (3,500 - 6,000 mg/kg). The significant difference between the acute and chronic HQ values is due in part to the rapid assimilation of subacute amounts of strychnine in avian and mammalian species.

Risk assessment results suggest that potential hazards exist for any birds likely to consume strychnine avicide baits. Nontarget hazards for these formulations have been specifically reported for mallards, brown-headed cowbirds, and meadowlarks. Overall, hazards are lower for pigeon bait strychnine corn and sparrow-cracks because these formulations are applied primarily in urban areas, where fewer nontarget bird species are likely to occur.

Primary hazards to the two potentially exposed listed species, the Attwater's greater prairie chicken and whooping crane, would not result from application of strychnine avicides because these two species are unlikely to occur in the habitats where the bait is applied.

Secondary. The risk assessment results addressing secondary exposures to the American kestrel are suggestive of potential hazard based on consuming strychnine-contaminated avian species from the above formulations. The maximum tissue concentration (21 mg/kg) for ingestion by the kestrel was based on the pigeon LD_{50} value, representing the highest projected body burden among all target species. The results indicate no potential hazard associated with acute toxicity, with a calculated HQ of 0.61. Chronic toxicity is of greater concern, with a HQ of 1.53. This chronic HQ is conservative, based on the metabolism of strychnine prior to death, as documented previously in the toxicity section. The soil pathway was found to be insignificant for the kestrel and coyote and did not exceed a HQ of 0.01 as shown in Table P-27.

Results of the quantitative risk assessment for the American kestrel suggest that chronic hazards may exist for other raptors, including three listed species (the peregrine falcon, northern aplomado falcon, and bald eagle). Specific secondary hazards have been reported for owls and gulls as well as for the peregrine falcon from consuming strychnine-poisoned pigeons. The reports did not indicate whether the secondary hazards to these

species resulted from short-term (acute) or longer-term (chronic) exposure. The key factor concerning the potential for secondary hazards to these species is their presence at or near the site of application.

Use of strychnine pigeon bait is specifically restricted within the documented range of the peregrine falcon. However, the peregrine falcon may be affected by consumption of prey poisoned by other formulations of strychnine avicides, such as the bird toxicant or sparrow-cracks. The northern aplomado falcon occurs within a very limited range in southern Texas. This species could be affected by chronic secondary toxicity if strychnine avicides were applied within its limited range. The bald eagle may also be affected by chronic secondary toxicity resulting from consumption of strychnine-poisoned prey. Bald eagles have been reported to be poisoned by strychnine, although the specific details were unknown. Overall, hazards to bald eagles are expected to be lower, because eagles are larger than falcons and the eagles' diet consists primarily of fish, with relatively lower proportions of avian or mammalian prey.

Secondary exposure to mammalian predators is assumed to be represented by the SRO 0.5 percent formulation (representative scenario) and is not expected to result in acute or chronic hazards to listed or nonlisted nontarget animals. Three listed mammals (jaguarundi, ocelot, and Louisiana black bear) occur within the range of use of these formulations, but are unlikely to be affected because of the low HQ value for the coyote and the low likelihood of occurrence in the habitats where strychnine avicides are applied.

Aquatic. Refer to the representative scenario (SRO 0.5 percent formulation) for the risk evaluation for this pathway.

(6) Conclusions

Primary Toxicity. Nontarget species may be at risk based on both acute and chronic exposures for the indicator species (eastern meadowlark). Actual risk to nontargets is expected to be low because few nontarget bird species occur in urban areas where the formulations are applied. There is no probable risk to the Attwater's greater prairie chicken or the whooping crane because these species are not likely to occur in the habitats where the formulations are applied.

Secondary Toxicity. Potential risk is expected with the American kestrel and three listed species (the peregrine falcon, northern aplomado falcon, and bald eagle) for chronic toxicity only. No probable risk is expected for mammalian predators, including listed species, because of the low HQ value for the coyote and the low likelihood of listed species (jaguarundi, ocelot, and Louisiana black bear) occurring in habitats where strychnine avicides are applied.

Aquatic. No probable risk is expected, based on low concentrations and significant degradation over time.

(7) Comparison of Findings with Those of USFWS and USEPA

The USFWS concluded that use of strychnine avicides to control damage by pigeons could adversely affect one listed species, the peregrine falcon (USFWS 1992). It is the biological opinion of USFWS that the APHIS ADC program will not jeopardize the continued existence of the peregrine falcon because present label restrictions on strychnine require five-mile buffers around identified aeries, which should protect most peregrines occurring in urban areas where pigeon bait is generally applied (USFWS 1992). USFWS did not specifically address potential impacts of strychnine pigeon bait to other listed species of raptors or potential impacts of other strychnine avicidal formulations to listed species.

None of the formulated products of strychnine were considered in USEPA's Request for Section 7 Consultation.

(8) Mitigation

Mitigation measures recommended by USFWS to protect the peregrine falcon from secondary toxicity hazards resulting from application of strychnine pigeon bait include: (1) establishing contact with either USFWS or state wildlife offices prior to any urban pigeon control; and (2) using alternative chemicals, such as DRC-1339, whenever possible (USFWS 1992).

It is recommended that these mitigation measures also be applied to strychnine sparrow-cracks and bird toxicant. Current label restrictions requiring users to pick up carcasses should be adequate to protect bald eagles. An additional appropriate mitigation measure may be to prohibit use of strychnine avicides within 5 miles of active bald eagle nests or roost sites.

s. Strychnine (Steam-Rolled Oats), 0.5 percent, and (Milo), 0.35 percent, Aboveground Use

(1) Use Pattern

Strychnine (Strychnine Milo), 0.35 percent. This end-use formulation is registered for both above- and below-ground uses for the control of pocket gophers and ground squirrels to protect alfalfa, livestock feed, trees, and property. Three States (NE, OR and TX) used this formulation between FY 1988 and 1991. The maximum annual aboveground use was 8 pounds (0.028 pound a.i.) in Nebraska. The maximum annual use for below-ground use was 690 pounds (2.42 pounds a.i.) in Oregon. This formulation was applied by approximately 21 APHIS ADC or APHIS ADC supervised employees. The maximum application rate varied from 1 to 10 pounds/acre based on the target species and method of application (above or below ground). This formulation was applied year-round, primarily on private lands. Strychnine-treated grains have not been used above ground by APHIS ADC personnel since USEPA suspended aboveground uses in 1988.

Strychnine (Steam-rolled Oats), 0.5 percent. This formulation is registered for the control of damage caused by pocket gophers, ground squirrels, and prairie dogs both above and below ground. This formulation was applied in three States (NE, NM, OR) between FY 1988 and 1991 for the protection of livestock feed, alfalfa, turf, trees, and rangeland. Approximately 20 APHIS ADC or APHIS ADC-supervised employees apply this formulation in the three States. The maximum annual use was 7,438 pounds (37.2 pound a.i.) in Oregon. The maximum application rate varied from 1 to 2 pounds depending on the target species and the method of application. This formulation was applied during the summer in Nebraska, spring and summer in New Mexico, and year-round in Oregon. This product has not been used above ground by APHIS ADC personnel since USEPA suspended aboveground uses in 1988.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Aboveground application of strychnine grain bait has occurred in pastures, croplands, and orchards (Hegdal and Gatz 1976; Albert and Record 1982; Holbrook and Timm 1985; Uresk et al. 1986; Schmatz et al. 1989). Strychnine milo and steam-rolled oats are used to control damage by voles, prairie dogs, ground squirrels, kangaroo rats, cotton rats, and jackrabbits.

Primary Nontarget Hazards. Any seed-eating animals occurring in areas where strychnine is applied would be would be affected by aboveground use of strychnine milo and steam-rolled oats. Aboveground application of 0.5 pounds strychnine bait in Wyoming resulted in significant kills of some seed-eating birds, especially horned larks and mourning doves (Hegdal and Gatz 1977a). The authors searched approximately 50 treated acres for affected nontargets and found a total of 129 dead birds, including 48 horned larks, 21 mourning doves, 18 red-winged blackbirds, 21 Brewer's blackbirds, 6 yellow-headed

blackbirds, four vesper sparrows, two brown-headed cowbirds, one American crow, one starling, one savannah sparrow, and one meadowlark. An average of 6.6 birds were found per hectare searched (2.7 birds per acre searched). Extrapolating these results to the entire treated area of 9,000 acres indicates that a total of 24,000 nontarget birds may have been killed.

Small mammals that were affected or found dead following aboveground application of strychnine included deer mice, western harvest mice, pocket mice, grasshopper mice, and woodrats (Wood 1965; Albert and Record 1982; Uresk et al. 1986). Potential nontarget receptors that are likely to consume strychnine bait include Canada geese, mallards, wood ducks, killdeer, gulls, northern flickers, blue jays, Steller's jays, black-billed magpies, northern cardinals, lark sparrows, chestnut-collared longspurs, rusty blackbirds, American goldfinches, purple finches, and house finches (Uresk et al. 1986; USEPA 1988).

Secondary Nontarget Hazards. Strychnine grain baits present a significant secondary hazard to predators and scavengers that consume strychnine-poisoned prey or carrion. The highest secondary risk results from consumption of small mammals that contain contaminated grain in their cheek pouches or gastrointestinal tract (Hegdal and Gatz 1977). Potentially exposed raptors include hawks, falcons, and owls. However, most raptors eviscerate prey before consumption, effectively eliminating their exposure to secondary poisoning (Cheney et al. 1987; Schmatz et al. 1989). Only one occurrence of affected raptors has been reported: two short-eared owls were found dead after ingesting kangaroo rats containing strychnine-treated grain in their cheek pouches (Piper 1927 in Hegdal and Gatz 1977a).

Mammals tend to be more susceptible to secondary hazards than birds because they generally do not eviscerate prey before consumption. Coyotes have been found dead after rangelands were treated for control of rodents and jackrabbits; one coyote's stomach contained the stomach of a jackrabbit (Garlough and Ward 1932; Wood 1965). Coyotes also were affected after consuming strychnine-poisoned ground squirrels during a lab study, even though the coyotes tended to reject portions of the gastrointestinal tracts of the poisoned squirrels (Marsh et al. 1987). Other potentially exposed species include badgers, foxes, weasels, martens, mink, fishers, raccoons, and skunks (Wood 1965; Hegdal and Gatz 1977a; Evans 1987d). Large mammals, such as bears, are less susceptible to secondary poisoning because they would have to consume large quantities of poisoned prey to reach a toxic threshold: one grizzly bear would have to consume 94 poisoned pocket gopher carcasses to be at risk (Barnes et al. 1985).

Strychnine baits also present a secondary hazard to predatory or carrion-eating herpetofauna. One prairie rattlesnake was found dead following application of strychnine to control rodents in New Mexico; the snake probably died as a result of eating small mammals poisoned by the bait (Campbell 1952). Gopher snakes were killed from consuming poisoned voles during a lab study (Brock 1972 in USEPA, no date). Additional potential nontarget receptors include bullsnakes, diamondback rattlesnakes, and night snakes (Wood 1965).

Domestic Animals. Domestic cats and domestic dogs are susceptible to secondary toxicity resulting from aboveground application of strychnine grain bait. One domestic dog was killed from consuming strychnine-poisoned ground squirrels after bait was applied both above and below ground (Schmatz et al. 1989).

Threatened and Endangered Species. One listed species, the whooping crane, occurring within the range of use of these formulated products would potentially be affected from consumption of strychnine-treated bait. Two additional listed species, the bald eagle and peregrine falcon, would potentially be affected be secondary toxicity from consumption of strychnine-poisoned prey. Use of strychnine grain bait is not specifically restricted within the range of these three species.

Twenty-eight bald eagles were known to have been poisoned or killed by aboveground use of strychnine between 1964 and 1986 (USFWS 1988a). While many of these strychnine poisonings may have been due to improper or inappropriate application methods, at least six deaths were the result of approved use of strychnine for ground squirrel control (USFWS 1988a).

Two additional listed species, the Aleutian Canada goose and the gray wolf, also occur within the range of use of these formulated products, but would not be affected because the label specifically restricts use of strychnine baits within the range of these species.

(3) Screening

The cumulative scores for the aboveground applications of strychnine milo and oats were 65 for aboveground use of 0.35 percent milo and 0.5 percent steam-rolled oats. All aboveground strychnine formulations were designated as warranting QRA. This designation for these aboveground formulations of strychnine is supported by: (1) potential hazards to threatened and endangered species; and (2) known acute and chronic toxicity to mammalian, avian, and aquatic species. Environmental fate properties and use pattern characteristics were relatively insignificant and did not materially affect the screening outcome.

(4) Exposure Assessment

(a) Indicator Species and Exposure Factors

The horned lark and the deer mouse were selected as the indicator species for primary toxicity of strychnine. Both species are year-round residents in Nebraska, the representative State, and are likely to occur in rangeland where strychnine is generally applied. Both the horned lark and the deer mouse forage primarily on insects during the summer, but their exposure to strychnine grain bait is highest during fall and winter when they feed on seeds and grains. These potential exposure factors are further supported by empirical data: 48 horned larks, in addition to 76 other birds of 10 species, were found dead following aboveground application of strychnine-treated oats to control ground squirrels in Wyoming (Hegdal and Gatz 1977a). Deer mice also have been affected following both aboveground and belowground application of strychnine grain bait (Wood 1965; Albert and Record 1982; Barnes et al. 1982; Evans et al. 1990).

The coyote, along with the American kestrel, was selected as the indicator species for addressing secondary toxicity of strychnine. Both the coyote and kestrel are likely to consume strychnine-poisoned birds or small mammals in rangeland where the bait is applied. The American kestrel is considered to be more exposed to strychnine because of its toxicological sensitivity, but the coyote was also selected to represent mammalian predators and scavengers. No kestrels have been reported to be affected from secondary hazards resulting from consumption of strychnine-poisoned prey. Several coyotes, however, have been reported as killed following application of strychnine in rangeland to control jackrabbits and rodents (e.g., Garlough and Ward 1932; Wood 1965).

Exposure Factors. Exposure factors for the horned lark were based on primary toxicity of strychnine grain baits. The lark was assumed to ingest approximately 15 percent of its body weight (5.6 g/d). The percentage of contaminated grain in the diet was assumed to be 50 percent for chronic exposures, but like the other grain-eating birds outlined above, could potentially consume 100 percent of its daily diet as grain. The exposure factors for the kestrel were outlined above for 4-aminopyridine and vary only according to prey concentration, based on the highest LD_{50} value. The coyote is likely to consume strychnine-poisoned birds or small mammals, which are estimated to constitute 54 percent of its diet. The fraction of range of the coyote is very large (more than 10,000 acres), yet the extent of strychnine use is also potentially widespread. Coyotes were assumed to be exposed to strychnine-poisoned bird or small mammal carcasses in one percent of their home range, based on an assumed 100-acre application area.

(5) Quantification of Exposure

Key Assumptions and Modeling Procedures. All of the eight formulations used by APHIS ADC in more than 15 States were identified to have potential impacts on several T&E species (see Table P-9). Strychnine is used by APHIS ADC less frequently as an avicide than as a rodenticide. It was assumed for the purposes of modeling that strychnine could be applied above ground as well as below ground and that aboveground applications are more likely to be transported off-site. Therefore, aboveground (0.5 percent) strychnine grain was selected for the representative modeling scenario for surface soil concentrations and off-site transport.

Aboveground 0.5 percent strychnine grain was applied in three States between FY 1988 and FY 1991: Nebraska, New Mexico, and Oregon. Nebraska was selected for the PRZM simulation because the average annual rainfall in southeastern Nebraska (MLRA: M-106) is relatively high, ranging from 75 cm to 92.5 (USDA 1981).

Chemical properties of strychnine used in PRZM included water solubility, soil half-life, K_{oc}, and vapor pressure and are provided in Table P-19. A maximum application rate of 10 pounds/acre (0.5 percent a.i.) and maximum frequency of once per year were used in the simulation to reflect conservative assumptions. Applications were assumed to be made on April 4, 1949, the heaviest documented year and month for rainfall.

The MLRA of M-106, which covers eastern Nebraska and Kansas, was selected for the PRZM simulation. The soil "Wymore" in this MLRA, recommended by PIC/PRZM as runoff potential soil, was selected following this recommendation. The texture of this soil is silty clay loam. Soil and hydrologic properties were estimated using the PIC/PRZM program and are presented in Table P-19.

Although strychnine may be ionized in the environment, very little information was found for ionized strychnine, and therefore only the neutral form was considered for the EXAMS modeling. Furthermore, no daughter compounds were considered in the simulations. The major process considered in the EXAMS modeling for strychnine is biodegradation. Hydrolysis was not considered, because hydrolysis of strychnine is not likely to occur at neutral pH (Mishalanie et al. 1989). Since few data regarding photooxidation and photodegradation in water were found for strychnine, the degradation rates from photooxidation and direct photolysis in water were assumed to be zero. Key parameters considered in the EXAMS modeling are provided in Table P-21.

Results for the Quantitative Exposure Assessment. The results of the short-term (21 day) and long-term (90 day) concentrations of strychnine in surface soil (upper 2 cm) are presented in Figures P-10 and P-11. These results indicate that the major declines of strychnine concentrations in surface soil occurred not only in conjunction with major rainstorms but probably by biodegradation as well. The highest surface soil concentration of strychnine was 0.23 mg/kg, which occurred at the day of application (April 5, 1949). Figure P-10 also shows the runoff and erosion of strychnine with each rainstorm.

The estimated dissolved and sorbed concentrations of strychnine in the water column and benthic compartments within the pond are shown in Figure P-12. The highest concentrations in the water column occurred during the first rainstorm after application (April 4, 1949): 0.0046 mg/L dissolved and 0.063 mg/kg sorbed.

Strychnine concentrations in benthic sediment started at zero (no direct loading to sediment), and increased with time until mid-June. The highest concentrations of strychnine in benthic sediment occurred during mid-June: 0.000025 mg/L in pore water and 0.000083 mg/kg in sediment, reflecting a relatively low rate of application. Results indicated that the predominant concentrations of strychnine residues remain in the water column instead of benthic sediment.

The results presented in Figure P-12 show that the dissolved and sorbed concentrations of strychnine in the water column (or benthic sediment) are of the same shape. This reflects the partitioning of strychnine concentrations between sorbed and dissolved phases.

(6) Risk Characterization

Primary. Results for the horned lark suggested evidence of highly toxic acute exposures based on ingestion of grain bait, supported by acute HQ values for 0.35 percent and 0.5 percent a.i. of 2,800 to 4,000, respectively (see Table P-27). The results also indicate high toxic chronic exposures to these two grain baits supported by a hazard quotient of 340 to 480, significantly less than the acute HQ value. These elevated values were based primarily on: (1) high orders of both acute and chronic toxicity to nontarget organisms; and (2) high concentrations in bait (3,500 - 5,000 mg/kg) at the time of application as well as 28 days later (2,800 - 4,000 mg/kg) due to slow aerobic degradation. The significant difference in the acute and chronic HQ values is due in part to the rapid assimilation of subacute amounts of strychnine in avian and mammalian species.

Exposure factors supporting the above calculations also contributed significantly to elevated HQ values. For example, the limited home range of the horned lark (approximately 13 acres) assumes 100 percent exposure at all times. These calculations also assume that the entire daily ingestion rate (5.6 g/day) occurs at the application site and consisted exclusively of strychnine-treated bait. The contribution from the soil pathway (0.5 percent formulation) to the horned lark appears minor, with corresponding hazard quotients of 0.02 and 0.01 for acute and chronic exposures to incidental soil ingestion, respectively. The acute HQ is significantly less than the cumulative HQ of 4,844 by up to five orders of magnitude and therefore not an important exposure concern.

Results addressing ingestion of rodent baits (0.35 percent and 0.5 percent) by the deer mouse are also suggestive of elevated acute and chronic toxicity, supported by acute HQ values of 7,200 to 10,300 and chronic HQs of 1,100 to 1,600. These elevated HQ values were attributable to the same primary exposure factors as the avian species, with 100 percent exposure because of the small home range (approximately 0.5 acre) and assuming 50 percent of the daily ingestion rate (2.3 g/day) occurred at the application site and consisted exclusively of strychnine-treated bait. The deer mouse also had minor hazards associated with incidental ingestion of contaminate soil (0.5 percent formulation), with corresponding HQ values of 0.05 and 0.01 for acute and chronic soil exposures, respectively.

Results of the quantitative risk assessment (both 0.35 percent and 0.5 percent formulations) for the horned lark and deer mouse suggest that primary hazards to other species, including listed species, are likely to occur. Hazards are highest for granivorous birds and mammals occurring in areas where strychnine bait is applied. Nontarget hazards resulting from use of both strychnine avicides and rodenticides have been specifically reported for mallards, mourning doves, horned larks, meadowlarks, blackbirds, brown-headed cowbirds, and sparrows as well as deer mice, western harvest mice, western jumping mice, pocket mice, grasshopper mice, woodrats, chipmunks, and rabbits.

Hazards to nontarget animals are highest for aboveground application of strychnine grain bait as a rodenticide in rangeland, because more species of granivorous birds and mammals are potentially exposed than for other formulations. Hazards for belowground application of strychnine grain bait are limited to small mammals co-occurring underground with the target animals. Birds would not be affected by this type of application because they are unlikely to consume grain bait applied underground.

Primary hazards potentially exist for one listed species, the whooping crane, occurring within the range of use of strychnine grain bait. Hazards are likely to occur only for aboveground application of strychnine grain bait in rangeland to control rodents. The whooping crane winters in New Mexico and migrates through Nebraska. This species is known to occur in rangeland and forage on grains. The whooping crane could be ad-

versely affected by consumption of bait applied within its wintering or migratory range. The Aleutian Canada goose also occurs within the range of use of this formulation, but would not be affected because use of strychnine grain bait is specifically restricted by the label within the range of this species.

Secondary. The results for secondary exposures to the American kestrel suggest there is potential hazard based on consuming strychnine-contaminated avian species. The maximum tissue concentration (14 mg/kg) for ingestion by the kestrel was based on the highest rat LD_{50} value, representing the highest projected body burden among all target rodent species. The results indicate that there is little hazard associated with acute toxicity, with a calculated HQ of 0.4. Chronic toxicity is slightly greater, with a HQ of 1.0. This chronic HQ is conservative, based on the metabolism of strychnine prior to death and considered indicative of no probable risk. The soil pathway was found to be insignificant for the kestrel and coyote and did not exceed a HQ of 0.01 as shown in Table P-27. The results for secondary toxicity to the coyote indicate little potential hazard, based on the stated assumptions, as shown in Table P-27 (HQ of 0.04 and less than 0.01 for acute and chronic, respectively). This is supported by the fact that not many dead prey organisms are expected to be ingested following application because of the extensive home range of the coyote, although a coyote could ingest high quantities of prey remains during a single event if such remains were available. Additionally, toxicological information (note acute and chronic benchmark values of 0.07 and 0.72, respectively) indicates that if an organism survives the acute effects, the material is metabolized, and chronic effects are therefore lower.

Results of the quantitative risk assessment for the American kestrel suggest that chronic hazards may exist for other raptors, including three listed species (the peregrine falcon, northern aplomado falcon, and bald eagle) occurring within the range of use of these strychnine formulations. Use of strychnine rodenticides is not specifically restricted within the range of these three listed species. Chronic hazards are potentially lower for belowground strychnine application, because most target animals are likely to die below ground, where they would not be available to scavenging or predatory raptors.

Risk assessment results for the coyote indicate that hazards to other large mammalian predators or scavengers are unlikely to occur. However, secondary hazards to coyotes and foxes have been reported in the literature. The implications of three listed mammals (ocelot, jaguarundi, Louisiana black bear) are similar to that of the coyote above: the key issue concerning the potential for nontarget secondary hazards to these species is their presence at or near the site of application. Past observations from the literature have indicated that such hazards may occur. The gray wolf and grizzly bear also could occur within the range of use of this formulation, but would not be affected because of specific label restrictions concerning the range of these species.

Aquatic. Results based on the exposure modeling in surface water (using EXAMS) to calculate exposure of freshwater fish to strychnine indicate little potential acute or chronic hazard. The corresponding HQ for subchronic aquatic exposures is 0.06, based on a maximum short-term water concentration of 0.0046 mg/L. The modeled 28-day water concentration of 0.00045 mg/L results in a chronic HQ value of less than 0.01, shown in Table P-16 and P-27. Chronic exposures to strychnine in water were emphasized because of the high sensitivity of the no-effect-concentration study selected.

(7) Conclusions

Primary Toxicity. Potential risk is anticipated for both acute and chronic oral exposures for the indicator species (horned lark and deer mouse), almost exclusively based on expected concentration and high susceptibility to bait formulations. Hazards are higher for aboveground application of grain bait, because more animals are potentially exposed to the bait than for below ground applications. Aboveground application of grain bait may potentially affect the whooping crane, which occurs within the range of use of these formulated products.

Secondary Toxicity. Potential risk is expected for chronic exposure for the American kestrel and other raptors, including three listed species (peregrine falcon, northern aplomado falcon, and bald eagle). No probable risk is expected for the coyote and other mammalian predators (including the listed jaguarundi and ocelot), based on low ingestion rates and low concentrations in prey.

Aquatic. No probable risk is expected, based on low concentrations and significant degradation over time.

(8) Comparison of Findings with Those of USFWS and USEPA

USFWS concluded that strychnine grain baits could adversely affect the Aleutian Canada goose if the bait is ingested by the geese (USFWS 1992). It is the biological opinion of USFWS that the APHIS ADC program will not jeopardize the continued existence of the Aleutian Canada goose, although the APHIS ADC program has the potential to cause incidental take (USFWS 1992). These conclusions differ from the risk assessment, which concludes that the Aleutian Canada goose is adequately protected by the label and no adverse effects are likely to occur.

Both USFWS and the risk assessment concluded that use of strychnine grain baits may pose risks to the whooping crane (USFWS 1988a, 1988b, 1992). USFWS further concluded that use of strychnine is not likely to jeopardize the continued existence of the whooping crane because the probability of strychnine poisoning of whooping cranes is quite low (USFWS 1988a, b) and because APHIS ADC restricts their own use of and does not recommend use of strychnine grain baits where whooping cranes are known or believed to be present (USFWS 1992). USFWS concluded that the bald eagle could be impacted from secondary poisoning by consuming animals killed by strychnine (USFWS 1988a, b, 1992). Because the present label restrictions require users to pick up carcasses of poisoned rodents, USFWS concludes aboveground use of strychnine is not likely to jeopardize the continued existence of the bald eagle, except the southwest population. The small number of breeding territories in New Mexico and Arizona warrants the biological opinion that aboveground use of strychnine is likely to jeopardize bald eagles in this region (USFWS 1992).

USFWS did not specifically address potential impacts of strychnine rodenticides to the peregrine falcon, but did conclude that the use of strychnine in the APHIS ADC program will not jeopardize the peregrine falcon.

None of the formulated products of strychnine were considered in USEPA's Request for Section 7 Consultation.

(9) Mitigation

No mitigation measures are recommended for the whooping crane because, according to the 1992 biological opinion, APHIS ADC does not use or recommend aboveground applications of strychnine grain baits where whooping cranes are known or believed to be present (USFWS 1992). In addition, the 1988 cancellation of above-ground uses of strychnine by USEPA remains in effect as of January 1994.

Current label restrictions requiring users to pick up carcasses should be adequate to protect all bald eagles, except the southwest population. USFWS also recommends prohibiting use of strychnine within 5 miles of an active nest or active winter or summer roost for bald eagles to further protect this species (USFWS 1992).

USFWS established reasonable and prudent alternatives to protect the southwest population of bald eagles from jeopardy. These required alternatives are: (1) to develop new label and use restrictions that would prohibit aboveground use of strychnine within a 10-mile radius of known bald eagle nest sites in Arizona and New Mexico during the nesting period (from mid-November through July); or (2) to contact USFWS Phoenix and

Albuquerque Field Offices for specific bald eagle habitat locations and nesting periods and prohibit use of strychnine within eagle habitat when the birds may be nesting (USFWS 1992).

t. Strychnine (Steam-Rolled Oats), 0.5 percent, and (Milo), 0.35 percent, Below Ground Use

(1) Use Pattern

The previous aboveground discussion of these two end-use formulations details the combined use pattern data within the APHIS ADC program.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Strychnine grain bait is applied below ground to control damage by pocket gophers in rangeland, pastures, hay fields, croplands, and coniferous forest plantations (Fagerstone et al. 1980; Barnes et al. 1985; Matschke and Hegdal 1990; Schafer 1991).

Primary Nontarget Hazards. No bird species would be affected by the use of application of strychnine grain bait below ground. Nontarget mammals that were found dead following belowground application include three deer mice, two western jumping mice, two yellow pine chipmunks, one black-tailed jackrabbit, one cottontail rabbit, and one western harvest mouse (Hegdal and Gatz 1976, Fagerstone et al. 1980; Barnes et al. 1982; Holbrook and Timm 1985; Evans et al. 1990). Potential nontarget mammals known to inhabit pocket gopher burrows include cottontail rabbits, grasshopper mice, kangaroo rats, and voles (Vaughan 1961, Uresk et al. 1986).

Secondary Nontarget Hazards. Secondary hazards resulting from belowground application of strychnine are similar to those identified above for aboveground use of strychnine. Overall, the secondary hazards are lower for belowground strychnine bait because many rodents die below ground after consuming the bait and are accessible only to badgers, bears, and other species that excavate soil. However, some small mammals that consume bait underground are found dead on the surface and do present a secondary hazard to other scavengers and predators.

Domestic Animals. Domestic cats and domestic dogs are susceptible to secondary toxicity resulting from belowground application of strychnine grain bait. One domestic dog was killed from consuming poisoned ground squirrels after strychnine grain bait was applied both above and below ground (Schmatz et al. 1989).

Threatened and Endangered Species. No listed species would be affected by consumption of strychnine grain bait because none are likely to occur below ground where the bait is applied. Five listed species occurring within the range of use of these formulated products would potentially be affected by secondary toxicity from consuming strychnine-poisoned prey: the ocelot, jaguarundi, northern aplomado falcon, bald eagle, and peregrine falcon. Use of strychnine grain bait is not specifically restricted within the range of these five species.

One additional listed species, the gray wolf, also occurs within the general range of use of these formulated products, but would not be affected because the label specifically restricts use of strychnine baits within the specific range of the gray wolf.

(3) Screening

The cumulative score for belowground application of these strychnine formulations was 54. This score was similar to the aboveground formulations of strychnine, but was slightly lower because of fewer potentially exposed nontarget animals. The score was

supported primarily by (1) potential exposure to threatened and endangered species; and (2) the acute (and, to some extent, chronic) toxicity of strychnine, which contributed 21 to the total score of 54.

(4) Exposure Assessment

Indicator Species and Exposure Factors. Refer to the discussion of the aboveground formulation for appropriate indicator species and exposure factor delineation.

(5) Risk Characterization

Refer to the discussion of the strychnine aboveground formulation risk characterization, for a discussion of the calculated risk.

(6) Conclusions

Primary Toxicity. Potential risk is expected for both acute and chronic oral exposures for the indicator species, the deer mouse, almost exclusively based on expected concentration and high susceptibility to bait formulations. Hazards are assumed to be higher for the aboveground application of the grain bait, because more animals are potentially exposed to the bait than for belowground applications. Belowground application HQ values were not calculated or extrapolated from the aboveground use because of similar concentrations.

Secondary Toxicity. Potential risk is expected for chronic exposure for the American kestrel and other raptors (from poisoned targets surfacing from burrows), including three listed species (peregrine falcon, northern aplomado falcon, and bald eagle). No probable risk expected for the coyote and other mammalian predators (including the listed jaguarundi and ocelot) based on low ingestion rates and low concentrations in prey.

Aquatic. No probable risk expected, based on low concentrations and significant degradation over time.

(7) Comparison of Findings with Those of USFWS and USEPA

Belowground use of strychnine grain baits was considered but a species specific USFWS Biological Opinion was not found necessary. belowground use of strychnine was not considered in USEPA's request for Section 7 Consultation.

(8) Mitigation

To reduce potential secondary hazards to peregrine falcons, northern aplomado falcons, and bald eagles, it is recommended that carcasses be picked up following bait application, use of strychnine be restricted in areas where these species are known to occur or concentrate, and zinc phosphide be used instead of strychnine whenever possible. General mitigation measures, such as removing unused bait, should reduce some primary hazards for these formulations also.

u. Strychnine, 1.6 percent, paste

(1) Use Pattern

The APHIS ADC program maintains a FIFRA Section 3 registration for this formulation, as well as a 24(c) label for Idaho. During FY 1988 through 1991 it was used only for the control of hares and jackrabbits in Idaho. The resources protected include alfalfa and bean crops. One APHIS ADC employee applied this product in Idaho. The maximum annual use was 6 pounds (0.1 pound a.i.), applied primarily during winter and to a lesser extent during spring. The treated area was rural, private land. This product not been used aboveground by APHIS ADC personnel since USEPA suspended aboveground uses in 1988.

(2) Potentially Exposed Nontarget Species

Primary Nontarget Hazards. No nontarget deaths have been reported for strychnine rabbit paste. Potentially exposed nontarget receptors include deer mice, voles, ground squirrels, deer, and other species likely to occur in areas where this formulated product is applied, and that are likely to consume alfalfa or carrot bait (Worthen, M., Personal communication, April 1992).

Secondary Nontarget Hazards. No secondary poisonings have been reported for this specific formulation of strychnine. Potentially exposed species in Idaho include coyotes and badgers. Raptors also may be exposed, but are unlikely to be affected because they generally eviscerate prey.

Domestic Animals. Domestic dogs and domestic cats are susceptible to secondary poisoning from consumption of contaminated prey or carrion.

Threatened and Endangered Species. Two listed species occurring in Idaho, the whooping crane and woodland caribou, would potentially be affected from consuming strychnine-treated alfalfa or carrot bait. Two additional listed species, the bald eagle and peregrine falcon, would potentially be affected by secondary toxicity from consuming strychnine-poisoned prey. Use of strychnine paste is not specifically restricted within the range of these four species.

Two additional listed species, the gray wolf and the grizzly bear, also occur within the range of use of this formulated product, but would not be affected because the label specifically restricts use of strychnine baits within the range of these two species.

(3) Screening

The cumulative score for strychnine paste was 55. The presence of four threatened and endangered species contributed significantly to this elevated score. This score is in keeping with all aboveground strychnine formulations as formulations that warrant QRA. Environmental fate properties and use pattern characteristics were relatively insignificant and did not materially affect the screening outcome.

(4) Exposure Assessment

Indicator Species and Exposure Factors. Refer to the representative scenario for similar indicator species, the deer mouse, and exposure factors related to the mouse.

(5) Risk Characterization

Primary. Results for ingestion of the 1.6 percent paste bait by the deer mouse indicate similar high levels of potential hazard to those indicated by the representative formulation. The acute HQ values for this formulation is 17,100. Chronic hazards are also elevated for the paste formulation, with a corresponding HQ of 2,700 (Table P-27).

Application of strychnine paste baits to control hares and jackrabbits may pose a risk for the whooping crane. This species migrates through Idaho and is known to forage on plants as well as grains and arthropods. The whooping crane could be affected by consumption of strychnine paste baits applied within its range during spring or fall migration. The woodland caribou would not be affected because this species does not occur within the range of areas damaged by marmots in Idaho (Connolly, G., Personal communication, July 1992).

Secondary. The elevated primary hazards and the relatively high score based on screening indicate that similar secondary effects could be assumed from the representative scenario. As indicated by the representative scenario, application of strychnine paste baits may result in secondary hazards to raptors, including two listed species (peregrine falcon and bald eagle) occurring within the range of use of these formulations. No probable risk is expected for the coyote, based on the low HQ values in the representative scenario.

Two listed mammalian predators (gray wolf and grizzly bear) would not be affected because use of strychnine paste baits is specifically restricted by the label within the range of these two species.

Aquatic. Results from the representative scenario modeling are adequate to represent this formulation.

(6) Conclusions

Primary Toxicity. Potential risk for strychnine paste formulations is expected, as indicated for the representative scenario (steam-rolled oats, 0.5 percent). Potential risk is expected for the whooping crane in Idaho during spring and fall migration. No probable risk for the woodland caribou because it does not occur within the range of areas damaged by marmots and woodchucks in Idaho.

Secondary Toxicity. Potential risk is expected for the American kestrel (chronic toxicity only) as well as two listed species (bald eagle and peregrine falcon) occurring within the range of use of these formulations, as indicated for the representative scenario. No probable risk is expected for coyote, based on low HQ values from low prey concentrations in the representative scenario. No probable risk is expected for the gray wolf and grizzly bear because use of strychnine baits is restricted by the label within the range of these two species.

Aquatic Toxicity: No probable risk is expected, based on low concentrations and significant degradation over time as indicated in the representative scenario.

(7) Comparison of Findings with Those of USFWS and USEPA

Both USFWS and the risk assessment concluded that strychnine paste baits could adversely affect bald eagles and peregrine falcons (USFWS 1982). USFWS further concluded that application of strychnine paste baits is not likely to jeopardize the continued existence of either the bald eagle or peregrine falcon (USFWS 1982).

USFWS did not address potential impacts of strychnine paste baits to the whooping crane. None of the formulated products of strychnine were considered in USEPA's Request for Section 7 Consultation.

(8) Mitigation

It is recommended that use of strychnine paste baits be restricted within the migratory range of the whooping crane during spring and fall migration to reduce hazards to this species. To reduce potential secondary hazards to peregrine falcons and bald eagles, USFWS recommends picking up rabbit carcasses, placing bait in furrows, restricting use of strychnine baits in areas where eagles are known to concentrate, and using zinc phosphide bait instead of strychnine whenever possible (USFWS 1982).

v. Strychnine, 4.9 percent, paste

(1) Use Pattern

This formulation has been used in two States (ID and WA) under Section 24(c) registrations. It was used by three APHIS ADC or APHIS ADC-supervised employees for the control of marmots and woodchucks to protect field crops and berries between FY 1988 and FY 1991. The paste is used near the edges of croplands and rangeland on private, rural land. The annual use ranged from 0.25 pound to a maximum of 70 pounds (0.012 pound and 3.43 pounds a.i.). The application rate varied from 16 g per quart of bait used for Idaho and 1.5 oz of bait for each burrow baited in Washington. It was applied primarily during the spring, with some baiting during the summer. This product not been used aboveground by APHIS ADC personnel since USEPA suspended aboveground uses in 1988.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Strychnine paste used for the marmot is placed above or below ground in rocky outcrop areas and , along the edges of pastures, crops, or orchards to control damage by marmots and woodchucks (Worthen, M., Personal communication, April 1992). Strychnine marmot paste has also been applied experimentally in a Douglas-fir plantation for the control of mountain beavers (Campbell and Evans 1988).

Primary Nontarget Hazards. Any animals likely to consume strychnine-treated alfalfa or dandelion bait could be affected by use of this formulated product. Several deer mice were found dead after applying strychnine marmot paste in eastern Washington (Pitzler, M., Personal communication, April 1992). Potential nontarget receptors include animals inhabiting marmot or woodchuck burrows, such as rabbits, chipmunks, voles, ground squirrels, opossums, raccoons, foxes, and skunks (Grizzell 1955; Schmeltz and Whitaker 1977). Deer would potentially be affected from consuming strychnine marmot paste applied above ground (Pitzler, M., Personal communication, April 1992).

Secondary Nontarget Hazards. Strychnine marmot paste presents a significant secondary hazard to predators and scavengers that consume strychnine-poisoned prey or carrion. Raptors are less susceptible to secondary poisoning because they often remove the contaminated gastrointestinal tract before consuming prey. Common ravens were observed in the area where dead marmots were found aboveground after bait application in eastern Washington. The ravens did not eat the stomach contents of dead marmots, and no deaths of ravens were reported (Pitzler, M., Personal communication, April 1992). Other potential nontarget receptors that may be exposed to secondary hazards include badgers, coyotes, foxes, and raccoons.

Domestic Animals. Domestic livestock are susceptible to poisoning from consumption of strychnine-treated alfalfa or dandelion greens. Domestic pets would be affected by secondary toxicity, particularly if they consume undigested strychnine from the gastrointestinal tract of poisoned prey.

Threatened and Endangered Species. Two listed species occurring within the range of use of this formulated product, the whooping crane and woodland caribou, would potentially be affected from consuming strychnine-treated alfalfa or carrot bait. Two additional listed species, the bald eagle and peregrine falcon, would potentially be affected by secondary toxicity from consuming strychnine-poisoned prey. Use of strychnine grain bait is not specifically restricted within the range of these four species.

Two additional listed species, the gray wolf and the grizzly bear, also occur within the range of use of this formulated product, but would not be affected because the label specifically restricts use of strychnine baits within the range of these two species.

(3) Screening

The cumulative score for strychnine 4.9 percent paste totaled 56. Like all other aboveground strychnine formulations, this score warrants that QRA be conducted. The presence of four threatened and endangered species contributes 45 percent of the score. Environmental fate properties and use pattern characteristics were relatively insignificant and did not materially affect the screening outcome.

(4) Exposure Assessment

Indicator Species and Exposure Factors. Refer to discussion of the 1.6 percent paste formulation, for similar indicator species and delineation of exposure factors.

(5) Risk Characterization

Primary. Results for ingestion of the 4.9 percent paste baits by the deer mouse indicate similar high levels of potential hazard to those indicated by the representative formulation. The acute HQ values for this formulation is 5,580 (see Table P-27).

Chronic hazards are also elevated for the paste formulation, with corresponding HQs of 880. The more concentrated bait (4.9 percent) is formulated into a less concentrated end product, accounting for the lower HQ values observed than those for the 1.6 percent paste formulation above.

Aboveground application of strychnine paste baits to control marmots and rabbits may potentially affect two listed species occurring in Idaho: the whooping crane and woodland caribou. The woodland caribou would not be affected because this species does not occur within the range of areas damaged by marmots and woodchucks in Idaho (Connolly, G., Personal communication, July 1992). The whooping crane migrates through Idaho and is known to forage on plants as well as grains and arthropods; this species could potentially be affected by consumption of strychnine paste baits applied within its range.

Secondary. The elevated primary hazards and the relatively high score based on screening indicate that similar secondary effects could be assumed from the representative scenario. As indicated by the representative scenario, application of strychnine paste baits may result in secondary hazards to raptors, including two listed species (peregrine falcon and bald eagle) occurring within the range of use of these formulations. No probable risk is expected for the coyote, based on the low HQ values in the representative scenario. Two listed mammalian predators (gray wolf and grizzly bear) would not be affected because use of strychnine paste baits is specifically restricted by the label within the range of these two species.

Aquatic. Results from the representative formulation modeling are adequate to represent this formulation.

(6) Conclusions

Primary Toxicity. Potential risk for both strychnine paste formulations is expected, as indicated for the representative scenario (steam-rolled oats, 0.5 percent). There is potential risk to the whooping crane in Idaho during spring and fall migration. No probable risk is expected for the woodland caribou because it does not occur within the range of areas damaged by marmots and woodchucks in Idaho.

Secondary Toxicity. There is potential risk to the American kestrel (chronic toxicity only) as well as two listed species (bald eagle and peregrine falcon) occurring within the range of use of these formulations, as indicated by the representative scenario. No probable risk is expected for coyote, based on low HQ values from low prey concentrations in the representative scenario. No probable risk is expected for the gray wolf and grizzly bear because use of strychnine baits is restricted by the label within the range of these two species.

Aquatic Toxicity: No probable risk is expected, based on low concentrations and significant degradation over time as indicated in the representative scenario.

(7) Comparison of Findings with Those of USFWS and USEPA

Both USFWS and the risk assessment concluded that strychnine paste baits could adversely affect bald eagles and peregrine falcons (USFWS 1982). USFWS further concluded that application of strychnine paste baits is not likely to jeopardize the continued existence of either the bald eagle or peregrine falcon (USFWS 1982).

USFWS did not address potential impacts of strychnine paste baits to the whooping crane.

None of the formulated products of strychnine were considered in USEPA's Request for Section 7 Consultation.

(8) Mitigation

It is recommended that use of strychnine paste baits be restricted within the migration range of the whooping crane to protect this species. To reduce potential secondary hazards to peregrine falcons and bald eagles, USFWS recommends picking up rabbit carcasses, placing bait in furrows, restricting use of strychnine baits in areas where eagles are known to concentrate, and using zinc phosphide bait instead of strychnine whenever possible (USFWS 1982).

w. Strychnine, 5.79 percent, Salt Block

(1) Use Pattern

This strychnine formulation was used in Oregon by one APHIS ADC employee to control porcupines from damaging new tree growth during FY 1988. The product registration was voluntarily withdrawn by APHIS ADC in 1989 and is no longer being used. The quantity used in 1988 was 100 blocks, which comprised 0.81 pound of strychnine with all used on private land. The method of control could potentially be used throughout the year, but little information was available to determine seasonal distribution.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Strychnine salt blocks are applied in coniferous forests to control damage by porcupines. The salt blocks are nailed to the trunk of trees about 8 inches above one of the larger branches and 10 feet or more above the snowline.

Primary Nontarget Hazards. Small mammals appear to be susceptible to poisoning from strychnine salt blocks. Two yellow-pine chipmunks and one northern flying squirrel were found dead following application of strychnine salt blocks in trees in Oregon (Anthony et al. 1986). Strychnine salt blocks were also placed in cubbies at the base of trees during this study, although this type of application was not used by the APHIS ADC Program. The cubbies were designed to prevent access to the salt blocks by large nontarget animals. This application resulted in the death of more nontarget animals, including seven yellow-pine chipmunks, five Nuttall's cottontails, four deer mice, three golden-mantled ground squirrels, and one Douglas squirrel (Anthony et al. 1986).

Birds would not be exposed to strychnine salt blocks. Deer would not be affected because salt blocks are placed at least 10 feet high on the trees, beyond the reach of foraging deer.

Secondary Nontarget Hazards. Predators and scavengers would be affected from consuming strychnine-poisoned prey and carrion. Raptors are less likely to be affected by secondary poisoning because they often remove the contaminated gastrointestinal tract before consuming prey. Potential nontarget receptors that occur in forested areas include foxes, weasels, martens, and coyotes.

Domestic Animals. Domestic livestock would not be affected because strychnine salt blocks are placed beyond their reach, at least 10 feet high on trees. Domestic pets may be affected by secondary toxicity resulting from consumption of strychnine-poisoned prey or carrion.

Threatened and Endangered Species. Three listed species occurring in Oregon, the bald eagle, peregrine falcon, and northern spotted owl, could be affected by secondary toxicity from consuming strychnine-poisoned prey. Use of strychnine salt blocks is not specifically restricted within the range of these three species. The Columbian white-tailed deer also occurs within the range of use of strychnine salt blocks, but would not be affected by primary toxicity because treated salt blocks are placed high enough to be beyond the reach of deer.

(3) Screening

The cumulative score for strychnine salt block was 53 indicating that QRA was warranted. The relatively small use pattern and the presence of three T&E species contributed to this somewhat low score compared to the other strychnine formulations. Environmental fate properties were relatively insignificant and did not materially affect the screening outcome.

(4) Exposure Assessment

Refer to discussion of the representative formulation, for the assumptions used to determine exposure to strychnine.

(5) Risk Characterization

Primary. The elevated primary hazard suggested by the representative formulation are assumed to adequately represent the salt block formulation. Primary hazards exist only for small mammals likely to consume the salt block bait applied on tree trunks. Nontarget hazards have been specifically reported for chipmunks, squirrels, deer mice, and rabbits. No listed species would be affected by primary toxicity because no listed species occurring within the range of use of this formulation are likely to consume salt block bait.

Secondary. The elevated primary hazards and the high screening score indicate that similar secondary effects could be assumed from the representative scenario. Chronic secondary hazards potentially exist for three species of raptors occurring within the range of use of this compound: the peregrine falcon, bald eagle, and northern spotted owl.

Aquatic. Results from the representative formulation modeling are adequate to represent this formulation.

(6) Conclusions

Primary Toxicity. There is potential risk to the above-mentioned nonlisted species for both acute and chronic oral exposures, almost exclusively because of high bait concentration and susceptibility to the active ingredient, based on representative scenario results. No probable risk is expected for listed species because none occurring within the range of use of this compound are likely to consume the strychnine salt block bait.

Secondary Toxicity. Potential risk is expected for chronic exposures to the American kestrel, based on the representative scenario. Secondary toxicity may also pose risks to three listed raptors occurring within the range of use of this compound: bald eagle, peregrine falcon, and northern spotted owl. No probable risk is expected for the coyote and other mammalian predators or scavengers, based on low HQ values from the representative scenario results.

Aquatic. No probable risk expected, based on low concentrations and significant degradation over time as indicated in the representative scenario.

(7) Comparison of Findings with Those of USFWS and USEPA

This formulated product was not addressed in USFWS's Biological Opinions or USEPA's Request for Section 7 Consultation.

(8) Mitigation

It is recommended that use of this product be restricted within the documented range of the bald eagle, peregrine falcon, and northern spotted owl to protect these three species. To reduce potential secondary hazards to these species, USFWS recommends picking up carcasses, restricting use of strychnine baits in areas where eagles are known to concentrate, and using zinc phosphide bait instead of strychnine whenever possible (USFWS 1982).

x. Aluminum Phosphide — AIP; CAS #20859-73-8

Aluminum Phosphide (Fumitoxin, Phostoxin, and Detia-Rotox), 55 percent or 57 percent

(1) Use Patterns

Three commercial formulations of aluminum phosphide tablets were used. The 3-gram tablets contains 55 percent or 57 percent of the a.i. The three formulations are federally registered as fumigants for the control of burrowing rodents and are restricted for use by certified applicators. Aluminum phosphide was used by APHIS ADC in five States (NE, NM, OK, OR, TX) between FY 1988 and 1991 to protect dikes, rangeland, turf, and other resources from burrowing rodent damage. Target rodents include pocket gophers, prairie dogs, moles, ground squirrels, muskrats, marmots, voles, and Norway rats. The maximum annual use in each State ranged from 2,211 tablets (8 pounds a.i.) in Texas to 89,141 tablets (324 pounds a.i.) in New Mexico, with a maximum application rate of 4 tablets per burrow. The majority of this product (96 percent) was used on private lands, both urban and rural. A total of approximately 35 APHIS ADC or APHIS ADC supervised employees applied this product, ranging from 2 to 15 per State. This method is most effective when applied in damp soil, which activates the gas. The compound was used throughout the year in the five States.

(2) Potentially Exposed Nontarget Species

Primary Nontarget Hazards. Any nontarget species inhabiting burrows where aluminum phosphide is applied could be killed. Use of burrow fumigants to control woodchucks in Ohio resulted in the death of one cottontail rabbit and three white-footed mice (Dolbeer et al. 1991). Potential nontarget mammals that are known to inhabit burrows of woodchucks or pocket gophers include chipmunks, deer mice, jumping mice, meadow voles, short-tailed shrews, ground squirrels, kangaroo rats, raccoons, foxes, weasels, striped skunks, opossums, and armadillos (Grizzell 1955; Vaughan 1961; Schmeltz and Whitaker 1977). The only nontarget bird species known to occur in burrows is the burrowing owl. Some species of reptiles and amphibians, such as rattlesnakes, lizards, turtles, and toads, also occur underground and could be affected by use of burrow fumigants.

Secondary Nontarget Hazards. No secondary hazards would result from use of aluminum phosphide burrow fumigants.

Domestic Animals. No domestic animals are likely to be affected by use of this formulated product.

Threatened and Endangered Species. Two species occurring in New Mexico, the Mexican gray wolf and the New Mexican ridge-nosed rattlesnake, would be adversely affected if aluminum phosphide fumigants were placed in burrows inhabited by these two species.

(3) Environmental Fate

Aluminum phosphide is not soluble in water, but will react with moist air to produce phosphine gas. It is stable under dry conditions. Aluminum phosphide is not persistent in soil systems because it decomposes to phosphine gas rapidly on contact with moisture in soil. The rate of decomposition of the tablets varies from less than 3 and up to 5 days or more, depending on moisture and temperature (MSDS). Ultimately, phosphine gas is transformed into harmless inorganic phosphate. The decomposition of aluminum phosphide (AlP) is represented by the following equation (Snider 1983):

$$2AeP + 6H_2O \rightarrow 2Ae(OH)_3 + 2PH_3$$

Laboratory experiments indicate that zinc phosphide, Zn_3P_2 (similar to aluminum phosphide), will completely decompose within about 30 days in moderately moist soils (Hilton and Robison 1972). Field studies suggest that decomposition occurs rapidly at first, particularly under rainy conditions (West et al. 1956).

Phosphine is a colorless gas with a vapor pressure of 33.5 atm at 20°C, much higher than other fumigants. This high vapor pressure generally prevents the accumulation of this gas in low areas, in spite of a specific gravity of 1.17, compared to a specific gravity for air of 1.0 (Snider 1983). Ultimately, phosphine is transformed into inorganic phosphate. Laboratory experiments that applied zinc phosphide to moist soils measured only trace concentrations of PH_3 gas over the soil mixture. These results indicate either concurrent absorption of the phosphine to the soil, followed by transformation to nonvolatile compounds or direct reaction of the Zn_3P_2 to produce nonvolatile phosphates, with PH_3 appearing only as a byproduct (Hilton and Robison 1972). The metal ions released by the dissociation of these phosphides are likely to adsorb to or precipitate in the soil, forming inorganic hydroxides or carbonates.

Aluminum phosphide is insoluble in water and therefore not expected to be particularly mobile in soils. At the same time, accumulation in soils is not significant due to the decomposition of aluminum phosphide in the presence of moisture. Zinc phosphide does not accumulate in animal tissue (Marsh et al. 1987), and similar metabolism may be expected of aluminum phosphide.

Evaluation of Off-Site Transport Potential. The primary exposure pathway for this formulation is via inhalation. Aluminum phosphide tablets kill burrowing rodents by releasing phosphine gas through decomposition by moisture in the burrow, causing chemical asphyxiation. The extent of area covered by this type of application is limited to the underground burrow. Because the primary route of exposure for aluminum phosphide is through inhalation within a closed burrow system, the determination of whether or not a nontarget will be exposed to the fumigant is of major concern (Snider 1983). The dose-response relationship of the a.i. is less significant because of its highly toxic nature.

The toxic gas produced, phosphine, is readily dispersed and not as potent when released into the atmosphere. Air transport was considered as a potential exposure pathway for this compound, based on key considerations, such as vapor pressure and the potential exposure associated with fumigants for which the primary mode of action involves inhalation. Because this fumigant is released within burrows or other confined (rather than ambient) spaces, no air modeling was required or warranted. No residues of phosphine will remain in the burrow for any length of time, and thus no secondary, chronic, or other exposures are expected to result. Exposure to aquatic organisms through off-site migration is not a likely pathway due to the volatility and insolubility of phosphine. It is not possible to quantify nontarget exposures using this method of control, which is consistent with the Section 7 Consultation findings (USEPA 1991b).

(4) Toxicology

Primary Toxicity. Aluminum phosphide is known for its extreme inhalation toxicity and reacts in the presence of moisture to release phosphine gas. Acute toxicity studies have been waived by USEPA because of its high toxicity; it has been placed in the highest toxicity category (USEPA 1991i). This high toxicity is reflected in the low lethal concentrations for rats, ranging from 1 to 40 ppm in air. The steep slope of the dose-response curve of phosphine gas implies that phosphine is extremely hazardous at doses slightly above a NOEL (Hachenburg 1972). The compound also exhibits high chronic toxicity, with the results of a 2-year rat study indicating a no-observable-effect (NOEL) of 0.03 mg/kg-d (Hachenburg 1972). The human median lethal dose has been reported as 20 mg/kg (USEPA 1991o), and it is rated "super" toxic, according to the IRIS data base (USEPA 1991i).

Secondary Toxicity. The potential for secondary toxicity is highly unlikely. Due to the mode of action (phosphine reacting within the respiratory system) and the extremely short half-lives in target organisms following death (Snider 1983), residue levels present in the target species are not high enough to produce the same effect in a predator or scavenger.

Because of the low potential for off-site transport and the high toxicity of the gas, no toxicological benchmark values were derived for aluminum phosphide.

(5) Screening

Aluminum phosphide burrow fumigants were designated as warranting further considerations, with a total cumulative score of 49. The score for biological considerations was 24 primarily due to the presence of two potentially exposed threatened and endangered species in the States where this compound was used. Aluminum phosphide is highly toxic, particularly within confined burrows, and received a toxicity score of 15.

(6) Exposure Assessment and Risk Characterization

Aluminum phosphide would affect any animal species, including threatened or endangered animals, non-listed animals, and domestic animals, that inhabits a burrow where a fumigant is applied to control a target species. This is apparent, based on acknowledged acute toxicity of the active.

However, the likelihood of impacts to nontarget animals is relatively low. The label for Phostoxin specifies that "all burrows should be checked for signs of nontarget animals, and if they are present, the burrow should not be treated." Thus, if the label is followed specifically by all users of Phostoxin, nontargets would not be expected to be adversely affected. Because it may be difficult, however, for users to determine the presence of nontargets within an underground burrow, the label may not be stringently followed in all situations, and some nontarget individuals could be killed.

Potential impacts to threatened and endangered species exist, but the likelihood of impacts is very remote. Out of the five States where aluminum phosphide burrow fumigants were applied, potentially exposed listed species occur only in New Mexico: the New Mexican ridge-nosed rattlesnake and the Mexican gray wolf. The rattlesnake occurs in a very limited range, between 5,600 and 8,000 feet elevation in the Animas Mountains in New Mexico. This species could be affected because it uses rodent burrows for shade or to escape from predators. The gray wolf would not be affected because it does not occur in small rodent burrows where aluminum phosphide fumigants are applied.

(7) Conclusions

Primary Toxicity. There is potential risk to nonlisted nontarget animals, although the likelihood of hazards is relatively low. There is potential risk to one listed species, the New Mexican ridge-nosed rattlesnake, if fumigants are applied in burrows occupied by this species. No probable risk to the Mexican gray wolf because it occurs in large dens and does not occur in small burrows inhabited by the target species.

Secondary Toxicity. No probable risk expected, based on rapid decomposition of phosphine in the target species.

Aquatic. No probable risk expected, based on minimal off-site transport.

(8) Comparison of Findings with Those of USFWS and USEPA

USFWS and the risk assessment concluded that the New Mexican ridge-nosed rattlesnake is potentially vulnerable to adverse impacts from the use of burrow fumigants within its occupied range. USFWS further concluded that use of aluminum phosphide within its range is likely to jeopardize the continued existence of this species (USFWS 1989a). Conversely, USEPA concluded "no effect" for the New Mexican ridge-nosed rattlesnake because control of target animals is not likely within its habitat (USEPA 1991b).

(9) Mitigation

USFWS established one reasonable and prudent alternative to protect the New Mexican ridge-nosed rattlesnake: to prohibit use of aluminum phosphide burrow fumigants above 6,000 feet elevation within the occupied range of this species (USFWS 1989a). Inspection of the dens for the presence of nontargets, as required by the labels, is sufficient to avoid most potential nontarget kills.

y. Brodifacoum (Weather Blok), 0.005 percent — $C_{31}H_{23}O_3Br$; CAS # 56073-10-0

(1) General Discussion

Brodifacoum is a "second-generation" anticoagulant rodenticide. It is formulated in bait blocks containing 0.005 percent active ingredient. The 20 g. Weather Blok is federally registered and used by APHIS ADC for the control of the Polynesian rat in Hawaii only. Approximately 37 pounds of Weather Blok (0.002 pounds a.i.) were applied in Hawaii in 1991. The maximum application rate specified in the label is 2-3 blocks at 15-foot intervals for 10 days or until signs of rat activity cease. This formulation was used year-round by a total of 12 APHIS ADC or APHIS ADC-supervised employees in both urban and rural settings. The compound was applied on Rose Atoll, a 16-hectare coral island of American Samoa. Brodifacoum was used to control depredations of sea turtle eggs by Polynesian rats. The bait is applied in tamper-proof boxes that are inaccessible to nontarget animals. Although brodifacoum is known to present a secondary hazard to raptors and scavengers (Merson and Byers 1984; Hegdal and Colvin 1988), no species of raptors or scavengers occur on Rose Atoll where brodifacoum is applied (T. Ohashi pers. comm. 4/92).

(2) Critical Element Screening

Based on the above discussion, there is very little likelihood that this product could contribute to nontarget effects. Accordingly, it was eliminated from further consideration, based on the criteria presented below.

(3) Documentation of Results

Primary Toxicity. No probable risk expected, based on critical element screening, because use of the formulated product is very specific in American Samoa where no nontarget species, including listed species, are exposed to the bait.

Secondary Toxicity. No probable risk expected because use of compound is very specific in American Samoa, where no predators or scavengers, including listed species, are exposed to secondary hazards.

Aquatic. No probable risk expected because of the low use and lack of vulnerable nontarget species.

Comparison of Findings with Those of USFWS and USEPA. This formulated product was not addressed in USFWS's Biological Opinions.

USEPA concluded that a "may affect" situation existed for listed species likely to consume bait attractive to commensal rodents or likely to consume brodifacoum-poisoned rodents in habitats where this formulated product is applied (USEPA 1991b). No listed species occurring on Rose Atoll are likely to feed on brodifacoum bait or poisoned rodents.

USEPA concluded that a "no effect" situation existed for aquatic toxicity because application of brodifacoum in tamper-proof bait boxes results in no chance for runoff into aquatic systems (USEPA 1991b).

z. Cholecalciferol (Quintox), 0.075 percent — $C_{27}H_{44}O$; CAS # 67-97-0

(1) General Discussion

Cholecalciferol, also known as Vitamin D3, is used therapeutically in humans. It is a nutrient and dietary food additive. It is used in humans to prevent rickets and other vitamin deficiency problems. The commercial use of cholecalciferol as a rodenticide has increased recently, especially for anticoagulant-resistant rodents. The toxic action of this rodenticide results from mobilization of calcium, causing mineralization of major organs and death within three to six days from hypercalcemia.

(2) Screening

(a) Use Patterns

This end-use formulation contains 0.075 percent cholecalciferol, also known as Vitamin D3. Cholecalciferol was used by APHIS ADC in Vermont under an experimental use permit for the control of chipmunks, deer mice, and squirrels to field-test its potential to reduce damage to maple sap tubing. The registered use of this compound specifies placement of bait in tamper-proof boxes or in burrows to control commensal rodents in and around buildings.The APHIS ADC use was outdoors, necessitating the EUP. Twenty-eight pounds of Quintox bait (0.021 pound a.i.) were used in 1990 by two APHIS ADC employees. The maximum application rate specified in the label is 8 ounces per 15-foot interval. Cholecalciferol was used equally during spring and summer on rural, private land.

(b) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Cholecalciferol is registered for application in and around homes, and industrial, commercial, agricultural, and other buildings to control damage caused by commensal rodents. This formulated product was applied in Vermont under an experimental use permit to reduce damage to maple sap tubing caused by chipmunks, deer mice, and squirrels in forested areas.

Primary Nontarget Hazards. No nontarget deaths were reported following experimental use of cholecalciferol in Vermont, and none were reported during past research by ADC personnel (Brown and Marshall 1988). Potential nontarget receptors identified in Vermont include snowshoe hares, cottontail rabbits, raccoons, striped skunks, and songbirds.

Secondary Nontarget Hazards. The risk of secondary exposure is low. No secondary hazards were apparent when domestic dogs were fed cholecalciferol-poisoned Norway rats during a laboratory study (Marshall 1984).

Domestic Animals. No domestic animals would be affected by use of this formulated product.

Threatened and Endangered Species. No threatened or endangered species are likely to be affected by use of cholecalciferol. The peregrine falcon and bald eagle occur in Vermont, but are unlikely to be affected because the risk of secondary toxicity is very low.

(c) Environmental Fate

Cholecalciferol is insoluble in water and therefore is not mobile in soils. Because cholecalciferol is a large organic molecule with molecular weight of 384.62 g, it is biodegradable in soils. However, there is very little information available on the degradation rate of cholecalciferol. Moderate persistence was assumed for screening purposes. Based on this assumption, cholecalciferol has the potential to accumulate in soils between applications.

It is reported that cholecalciferol as a rodenticide presents little or no potential for secondary hazards to predators and scavenging animals (Brown and Marshall 1988; Marsh and Koehler 1990); therefore, it is not expected to bioaccumulate in plant or animal tissues.

(d) Toxicology

Cholecalciferol, also known as Vitamin D3, accumulates primarily in the liver of birds and mammals. The compound is metabolized into other compounds that enter the blood stream and disrupt calcium regulation (Marshall 1984). Vitamin D3 is also taken by humans for therapeutic purposes (HSDB 1991i). The compound has a unique stop-feed action, according to Brown and Marshall (1988), which reduces the excess unused compound within the target's gut. Due to the nature and physical characteristics of the technical grade material and the formulated bait, several acute-hazard evaluation studies were waived by the USEPA.

The bait produces low oral and dermal toxicity (Marshall 1984). Studies indicate that cholecalciferol produces relatively low oral toxicity in avian and canine species. Cats seem to be most susceptible and poultry least susceptible, with the dog in between (Clarke and Clarke 1975). Marshall (1984), however, found that the dietary toxicity to mallards (48 mg/kg) was much lower than a previously documented LD_{50} value of 600 mg/kg. Primary acute lethality in dogs occurs at 13 - 26.4 mg/kg (Clarke and Clarke 1975; Marshall 1984). Beagle dogs fed rats poisoned by cholecalciferol baits for 14 days were not secondarily affected (Marshall 1984). This study concluded that the six dogs were not able to consume enough toxic bait secondarily to pose a hazard. Another study investigated secondary toxicity to snakes consuming mice fed on with cholecalciferol (Marsh and Koehler 1990). The mice were given twice the LD_{50} level of cholecalciferol and fed to the snakes prior to death, with no adverse symptoms occurring in the snakes.

(3) Documentation of Results

This commensal rat and mouse bait received a cumulative score of 22 in the screening and was classified as a "no probable risk" compound. The category that influenced the determination of low potential hazard was the low number for nontarget receptors and the lack of hazards to threatened and endangered species. The compound scored the highest in the category of toxicity, but it is only slightly toxic, with a score of nine (9). All scores were relatively low, and the compound can be assumed to pose little potential hazard to nontargets.

Primary Toxicity. No probable risk is expected, based on the screening process, because the formulated product was used in only one State (Vermont) where no listed species are likely to consume bait.

Secondary Toxicity. No probable risk because the risk of secondary exposure is very low.

Aquatic. No information available.

aa. Sodium Nitrate — $NaNO_3$; CAS # 7631-99-4

(1) General Discussion

Sodium nitrate is used in a pyrotechnic fumigant that emits toxic fumes when burned. Unless ignited, the components, sodium nitrate and charcoal, are relatively nontoxic orally. This product has been manufactured for more than 40 years at the APHIS ADC Pocatello Supply Depot. The rodent formulation used during FY 1988 through 1991 contained eight ingredients (see label in EIS Appendix Q). A two-ingredient gas cartridge is used in predator, namely the coyote, dens.

(2) Environmental Fate

Sodium nitrate is a naturally occurring substance. Although stable under dry conditions, it is readily soluble in water and likely to be highly mobile in soils. In addition, dissolved nitrate is very mobile, moving quickly through the vadose zone to the underlying water table (Bouwer 1989). The use of sodium nitrate through pyrolysis is believed to produce mostly simple organic and inorganic gases (USEPA 1991g). The gas given off by the sodium nitrate cartridge eventually disperses harmlessly into the atmosphere. This gas, along with other components of the cartridge, are likely to form oxides of nitrogen, carbon, phosphorus, and sulfur. These products are environmentally nonpersistent because they are likely to be metabolized by soil microorganisms or enter their respective elemental cycles. Sodium nitrate is not expected to accumulate in soils between applications, nor does it accumulate in the tissues of target animals (USEPA 1991g).

Under anaerobic conditions, nitrate may be used as an oxygen source by microorganisms and thereby degraded. The microbial conversion of nitrate to nitrogen requires the presence of an external source of carbon for cell synthesis (Metcalf & Eddy 1979).

Evaluation of Off-Site Transport Potential. When using sodium nitrate as a fumigant in burrows or dens, the toxic gas produced is carbon monoxide, which causes death by chemical asphyxiation. Dissipation is virtually instantaneous (Savarie et al. 1980), and therefore no hazardous residues are expected to remain in the air or in soil. Target animals are usually affected within 3 minutes of exposure. The use of food-grade sodium nitrate as a color-fixing agent in meat is accepted by the USDA in small concentrations, indicating that ingestion of small amounts of nitrates is harmless (Savarie et al. 1980).

Air transport was considered to be a potential pathway for these compounds, based on vapor pressure and the potential for exposure associated with fumigants for which the primary mode of action involves inhalation. Because these fumigants are released within burrows or other confined (rather than ambient) spaces, no air modeling was warranted. No residues remain at the site of application for any period of time, and it is therefore not possible to estimate exposure point concentrations.

(3) Toxicology

Sodium nitrate has been placed in the highest toxicity category because of inhalation hazards. Lethality occurs at 200 ppm in air for humans. The potential for secondary toxicity is unlikely because residues are nonexistent. The human health drinking water tolerance level is 10 mg/L, a relatively large amount, according to USEPA Quality Criteria for Water (1986c).

Primary Toxicity. Sodium nitrate is known for its high inhalation toxicity from the release of carbon monoxide when ignited. Acute toxicity studies have therefore been waived by USEPA, and the pesticide has been placed in the highest toxicity category, similar to aluminum phosphide. Acute ingestion studies are available and indicate high toxicity to avian species (4 to 21 mg/kg) and a lower toxicity to mammals, ranging from 1.2 mg/kg for lethality to dogs and domestic animals to as high as 3,700 mg/kg in rats (USEPA 1991g; Cerven 1990e; USEPA 1992b).

Secondary Toxicity. The potential for secondary toxicity is very unlikely. Due to the mode of action, suffocation by carbon monoxide, residues present in the carcasses of target species would not produce the same effect in a scavenger or predator. Carbon monoxide is a common air constituent and only produces the desired effect within the confined space of the burrows or dens.

Because of the low potential for off-site transport and high acute toxicity, no toxicological benchmark values were derived for aluminum phosphide.

ab. Sodium Nitrate (Gas Cartridge for Rodents), 43.36 percent

(1) Use Patterns

The sodium nitrate gas cartridge is a widely used rodenticide. Each 85 g cartridge contains 43.36 percent sodium nitrate and smaller amounts of sulfur, charcoal, red phosphorus, mineral oil, sawdust, and two inert ingredients. This formulation is registered for control of ground-squirrels, pocket gophers, marmots, woodchucks, and prairie dogs. It was used from FY 1988 to 1991 in 15 States (CA, ID, IN, KY, LA, MN, NM, ND, NE, OH, OK, OR, TN, TX, WV). Maximum annual use ranged from five cartridges (0.41 pound a.i.) in Oklahoma and Indiana to 1,090 cartridges (89 pounds a.i.) in Oregon, with a maximum application rate of one cartridge per burrow. This method was used throughout the year in most States in both urban and rural areas and, on private or public land by approximately 47 APHIS ADC or APHIS ADC-supervised employees.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Sodium nitrate gas cartridges are placed in burrows in rangelands, pastures, open fields, lawns, and golf courses to control damage by burrowing animals, including prairie dogs, ground squirrels, pocket gophers, woodchucks, and skunks.

Primary Nontarget Hazards. Any nontarget species inhabiting burrows where sodium nitrate gas cartridges are applied could be killed. Use of burrow fumigants to control woodchucks in Ohio resulted in the death of one cottontail rabbit and three white-footed mice (Dolbeer et al. 1991). Potential nontarget mammals that are known to inhabit burrows of woodchucks or pocket gophers include chipmunks, deer mice, jumping mice, meadow voles, short-tailed shrews, ground squirrels, kangaroo rats, raccoons, red foxes, gray foxes, long-tailed weasels, striped skunks, opossums, and armadillos (Grizzell 1955; Vaughan 1961; Schmeltz and Whitaker 1977). The only nontarget bird species known to occur in burrows is the burrowing owl. Some species of reptiles, amphibians, and invertebrates, such as rattlesnakes, lizards, turtles, and toads, occur in burrows and also would be affected by use of gas cartridges.

Secondary Nontarget Hazards. No secondary hazards would result from use of sodium nitrate gas cartridges.

Domestic Animals. No domestic animals would be affected by use of this formulated product.

Threatened and Endangered Species. Use of sodium nitrate gas cartridges would potentially affect any of the following 13 species that occur in burrows within the range of use of this formulated product:

- Fresno kangaroo rat
- Giant kangaroo rat
- Morro Bay kangaroo rat
- Stephens' kangaroo rat
- Tipton kangaroo rat
- Salt marsh harvest mouse
- Point Arena mountain beaver
- Gray wolf
- New Mexican ridge-nosed rattlesnake
- San Francisco garter snake

- Desert tortoise
- Santa Cruz long-toed salamander
- Island night lizard

Five additional listed species, the black-footed ferret, the San Joaquin kit fox, the blunt-nosed leopard lizard, the gopher tortoise, and desert tortoise, also occur in burrows within the range of use of this formulated product. These species would not be affected because the label specifically restricts use of sodium nitrate gas cartridges within the identified range or critical habitat areas of these species.

(3) Screening

This formulation of the sodium nitrate gas cartridge fumigant scored a total of 64 and was designated as warranting QRA. The score for biological considerations was high (25) because of the presence of nine potentially exposed threatened and endangered species occurring in the States where this compound is used. The fumigant is also highly toxic, particularly within confined burrows, and received a toxicity score of 23.

(4) Exposure Assessment and Risk Characterization

Hazards to nontargets resulting from use of sodium nitrate gas cartridges for rodents are similar to those identified previously for aluminum phosphide. Sodium nitrate gas cartridges could affect any animal species, including threatened or endangered animals, nonlisted animals, and domestic animals, that inhabits a burrow where a fumigant is applied to control a target species.

Like aluminum phosphide, however, the likelihood of impacts to nontarget animals is relatively low. The label for the gas cartridge specifies to "check all burrows for signs of nontarget species. If present, do not treat burrows." Thus, if the label is followed specifically by all users of sodium nitrate gas cartridges, no nontargets would be affected. However, because it may be difficult for users to determine the presence of some nontargets within an underground burrow, the label may not be stringently followed in all situations, and some nontarget individuals may be killed.

Empirical evidence suggests that nontarget hazards are low. Application of sodium nitrate gas cartridges by the APHIS ADC Program resulted in no reported deaths of nontarget animals during fiscal year 1988. Although many potential nontarget hazards exist, only one occurrence of actual nontarget death has been reported: three white-footed mice and one cottontail rabbit were killed after application of gas cartridges to kill woodchucks in Ohio (Dolbeer et al. 1991).

Hazards to threatened and endangered species may be higher for sodium nitrate gas cartridges than for aluminum phosphide because gas cartridges were applied in more States between FY 1988 and 1991, potentially exposing more listed species. A total of 17 listed species that would potentially be exposed to use of this compound occur in six of the States where this formulated product was applied (see Table P-9). Four of these species, the black-footed ferret, San Joaquin kit fox, blunt-nosed leopard lizard, and gopher tortoise, would not be affected because the label specifically prohibits use of the formulated product within the range of these species. One additional species, the gray wolf, also would not be affected because it occurs in large dens and does not occur in small burrows inhabited by the target rodent species. The remaining 12 species (5 species of kangaroo rats, the salt marsh harvest mouse, Point Arena mountain beaver, New Mexican ridge-nosed rattlesnake, San Francisco garter snake, island night lizard, desert tortoise, and Santa Cruz long-toed salamander) are likely to occur in small rodent burrows and could be affected by use of sodium nitrate gas cartridges within their ranges.

(5) Conclusions

Primary Toxicity. There is potential risk to nonlisted animals, although the likelihood of exposure is low because nontarget species rarely are found in burrows occupied by the target species. May potentially affect 12 listed species likely to occur in burrows within the range of use of this compound: five species of kangaroo rats, the salt marsh harvest mouse, Point Arena mountain beaver, New Mexican ridge-nosed rattlesnake, San Francisco garter snake, island night lizard, desert tortoise, and Santa Cruz long-toed salamander. No probable risk is expected to the gray wolf because it does not inhabit small rodent burrows. No probable risk is expected for the black-footed ferret, San Joaquin kit fox, blunt-nosed leopard lizard, and gopher tortoise because the label specifically prohibits use of the formulated product within the range of these species.

Secondary Toxicity. No probable risk expected, because toxicity results from inhalation and the decomposition product is an innocuous gas.

Aquatic. No probable risk is expected because off-site transport is minimal.

(6) Comparison of Findings with Those of USFWS and USEPA

USFWS and the risk assessment both concluded that eight listed species could be adversely affected by use of sodium nitrate gas cartridges in rodent burrows. These eight species are the Fresno, giant, Morro Bay, and Tipton kangaroo rats; the salt marsh harvest mouse; the New Mexican ridge-nosed rattlesnake; the San Francisco garter snake, and the desert tortoise (USFWS 1989a, 1992). USFWS further concluded that use of sodium nitrate gas cartridges in rodent burrows was likely to jeopardize the existence of one species, the New Mexican ridge-nosed rattlesnake (USFWS 1989a).

USEPA and the risk assessment both concluded that three additional species could be adversely affected by use of sodium nitrate gas cartridges: the Stephens' kangaroo rat, island night lizard, and Santa Cruz long-toed salamander (USEPA 1991b). These three species were not addressed in the USFWS Biological Opinions.

One additional species, the Point Arena mountain beaver, was not addressed by USEPA or USFWS. This subspecies of mountain beaver was listed as endangered on December 12, 1991 (56 *Federal Register* 64716). It inhabits underground burrows within a very limited range in Mendocino County, CA. The risk assessment concluded that this species could be affected by use of sodium nitrate gas cartridges within its range.

(7) Mitigation

USFWS established reasonable and prudent alternatives to protect listed species as follows:

- Prohibit use of sodium nitrate gas cartridges above 6,000 feet elevation within the occupied range of the New Mexican ridge-nosed rattlesnake (USFWS 1989a).
- Conduct surveys prior to application of rodent control agents within the recognized range of the Fresno, giant, Morro Bay, and Tipton kangaroo rats and initiate consultation with USFWS immediately if listed rats are found within any proposed rodent control treatment areas (USFWS 1992).
- Prohibit use of rodenticides in and around the salt and brackish marshes of San Francisco, San Pablo, and Sisan Bays, CA, to protect the salt marsh harvest mouse (USFWS 1992).
- Prohibit use of sodium nitrate gas cartridges in San Mateo County, CA, to protect the San Francisco garter snake, unless proposals for use are first reviewed and approved by USFWS in the Sacramento office (USFWS 1992).
- Sodium nitrate gas cartridges shall be used within the range of the desert tortoise only by qualified individuals.

One additional appropriate mitigation measure may be to prohibit use of sodium nitrate gas cartridges within known or likely habitats of the Point Arena mountain beaver in Mendocino County, CA.

ac. Sodium Nitrate (Gas Cartridge for Coyotes), 65 percent

(1) Use Patterns

This gas cartridge contains a mixture of sodium nitrate (65 percent) and charcoal. The cartridge is larger than the rodent gas cartridge, and was designed for control of coyotes in dens to reduce livestock depredation. This two-ingredient cartridge was developed because it was simpler to register than the eight-ingredient mixture. Between FY 1988 and 1991, 14 States (CA, CO, ID, MT, ND, NE, NM, NV, OR, OK, TX, UT, WY, and WA) used the gas cartridge for the control of coyotes. The maximum annual use was 677 cartridges (233 pounds a.i.) in California. The usual application rate is one cartridge per den.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Sodium nitrate gas cartridges were applied in rangeland to control coyote depredation of threatened and endangered species and livestock. The fumigants are placed only in active coyote dens. In some states, this product may also be used in red fox dens.

Primary Nontarget Hazards. Any animals inhabiting burrows where sodium nitrate gas cartridges are applied could be affected by use of this formulated product. The gas cartridges are placed only in active dens with coyote or fox pups. The likelihood of other animal species, except perhaps invertebrates, occurring along with target species in active dens is very low. Application of gas cartridges in 98 active coyote dens in five western States resulted in the death of 500 coyote pups and six adult coyotes; no nontarget receptors were found in any of the excavated dens (Savarie et al. 1980, Connolly, G., Personal communication, March 1992).

Secondary Nontarget Hazards. No secondary hazards would result from use of sodium nitrate gas cartridges.

Domestic Animals. No domestic animals would be affected by use of this formulated product.

Threatened and Endangered Species. The following listed species would potentially be affected if they co-occur with coyotes in active dens that are treated with sodium nitrate gas cartridges:

- Utah prairie dog
- Black-footed ferret
- New Mexican ridge-nosed rattlesnake
- Blunt-nosed leopard lizard
- Desert tortoise
- San Francisco garter snake
- Wyoming toad

Use of sodium nitrate gas cartridges is not specifically restricted within the range of these seven species.

Two additional species, the San Joaquin kit fox and the gray wolf, would not be affected because the label for this formulated product specifically restricts use in areas where these species are known to have dens.

(3) Screening

This predacidal formulation received an overall score of 59. This score is based on the presence of three potentially exposed threatened and endangered species and the moderately high toxicity of the active ingredient. In addition, environmental fate, especially mobility, contributed to the high score.

(4) Exposure Assessment and Risk Characterization

Use of sodium nitrate gas cartridges for coyotes potentially present nontarget hazards similar to those associated with the sodium nitrate gas cartridges for rodents. However, actual risks resulting from use of coyote gas cartridges are lower because they are applied only in active coyote or fox dens during the spring when pups are present. Coyote and fox dens may be easier to check for nontarget animals than underground rodent burrows. Also, no nontarget animals are expected to co-occur with carnivores in active dens. Empirical evidence also suggests that nontarget hazards are minimal: no dead nontarget animals were found after gas cartridges were placed in 98 dens (Savarie et al. 1980; Connolly, G., Personal communication, March 1992), and no nontarget deaths were reported as a result of APHIS ADC Direct Control in 14 States during FY 1988.

Hazards to listed species may occur if gas cartridges are placed in dens inhabited by listed species. Nine threatened and endangered species are listed in Table P-9 as potentially affected by use of this formulated product. Two species, the San Joaquin kit fox and the gray wolf, would not be affected because the label specifically prohibits use of the formulated product within the range of these species. The remaining seven species (Utah prairie dog, black-footed ferret, New Mexican ridge-nosed rattlesnake, blunt-nosed leopard lizard, desert tortoise, San Francisco garter snake, and Wyoming toad) also would not be affected because they are unlikely to co-occur with coyotes or foxes in active dens.

(5) Conclusions

Primary Toxicity. There is potential risk to nonlisted nontarget animals, although the likelihood of hazards is relatively low. No probable risk expected for the San Joaquin kit fox or gray wolf because the label prohibits use within the range of these two species. No probable risk to other listed species in the 14 States where the gas cartridges were applied because none are likely to co-occur with carnivore in active dens.

Secondary Toxicity. No probable risk is expected, because toxicity results from inhalation and decomposition product is an innocuous gas.

Aquatic. No probable risk is expected because off-site transport is minimal.

(6) Comparison of Findings with Those of USFWS and USEPA

USFWS concluded that one species, the blunt-nosed leopard lizard, could be adversely affected by use of predator fumigants (USFWS 1992). This finding differs with the conclusion of the risk assessment that blunt-nosed leopard lizards and other listed species are unlikely to occur in predator dens.

This formulated product was not specifically addressed by USEPA's Request for Section 7 Consultation.

(7) Mitigation

No mitigation is necessary, because burrows are investigated for the presence of susceptible nontarget species, as specified on the label.

ad. Zinc Phosphide — Zn_3P_2; CAS #1314-84-7

(1) General Discussion

Zinc phosphide is one of the most widely used rodenticides throughout the world. It can have toxic effects from a single dose, but because of its offensive taste and odor, pre-baiting with untreated bait is usually required to achieve consumption of a lethal dose. Zinc phosphide is available either as a concentrate (63 percent a.i.) that users mix with food baits at application sites or as ready-to-use grain baits or pellets (1 to 2 percent a.i.). APHIS ADC personnel use zinc phosphide mostly on grain baits applied to pastures, rangelands, or field borders to kill burrowing rodents (prairie dogs, ground squirrels) or mice that damage range vegetation, forage, or food crops.

In the United States, zinc phosphide is used by many individuals and organizations outside the APHIS ADC program. However, it can only be used by State-certified pesticide applicators. Approximately 50 APHIS ADC program employees used one or more zinc phosphide products in 13 States throughout the United States in direct control activities during FY 1988 through 1991 (Table P-7). Maximum annual use from all eight formulations during these years totaled 536 pounds of active ingredient. Zinc phosphide products were used throughout the year. Most APHIS ADC program uses of zinc phosphide during FY 1988 through 1991 occurred on rural, private lands; the remainder was on public land, mostly State-owned rangeland.

(2) Environmental Fate

Zinc phosphide is a finely ground gray-black powder that is practically insoluble in water (its solubility is less than 1 ppm) and alcohol and therefore not likely to be mobile in soils. It breaks down into elemental zinc and phosphine gas when exposed to moisture or under acidic conditions. The decomposition rate of zinc phosphide in soils depends on soil moisture and pH, with complete decomposition within 30 days in moderately moist soils (Hilton and Robison 1972). The residue of zinc phosphide is not expected to accumulate in the soils between applications or in animal tissues. The use of lecithin-mineral oil for increased adhesion of zinc phosphide to grain bait offers protection against moisture, therefore increasing its stability under field conditions (Hood 1972).

Phosphine, the decomposition product, is a colorless gas with a vapor pressure of 33.5 atm at 20°C, much higher than other fumigants. This high vapor pressure generally prevents the accumulation of this gas in low areas, in spite of a specific gravity of 1.17, compared to a specific gravity for air of 1.0 (Snider 1983).

Ultimately, phosphine is transformed into inorganic phosphate. Laboratory experiments that applied zinc phosphide to moist soils measured only trace concentrations of PH_3 gas over the soil mixture. These results indicate either concurrent absorption of the phosphine to the soil, followed by transformation to nonvolatile compounds or direct reaction of the Zn_3P_2 to produce nonvolatile phosphates, with PH_3 appearing only as a byproduct (Hilton and Robison 1972). The metal ions released by the dissociation of these phosphides are likely to adsorb to or precipitate in the soil, forming inorganic hydroxides or carbonates. At the same time, due to the decomposition of zinc phosphide in the presence of moisture, accumulation in soils is not expected to occur to any significant degree. Zinc phosphide has not been shown to accumulate in animal tissue.

Evaluation of Off-Site Transport Potential. The use of the 63 percent concentrate formulation for control of muskrats and nutria includes applying the material on floating rafts rather than on the ground. This application could therefore represent a direct route of exposure via the water (i.e., to aquatic organisms). It is possible that zinc could be transported from the floating raft to the water body or from the baiting zones via surface water runoff or via erosion to receiving water bodies, where elemental zinc toxicity could

become an issue. In addition, this material was widely used by the APHIS ADC program, and the amount of off-site transport of zinc would be significant; environmental exposure modeling is warranted for this active ingredient.

(3) Toxicology

Hill and Carpenter (1983) noted that zinc phosphide is two to 15 times more toxic to rodents than to carnivores. Mammal LD_{50} values were below 75 mg/kg and a few were below 10 mg/kg (see Table P-11 for the list of species and toxicity). Acute toxicity studies on 10 species of birds indicate high avian toxicity (10 mg/kg) (Matschke and LaVoie 1987). Secondary poisoning to predators and raptors is possible, especially if the chemical is not assimilated into the target species. Aquatic toxicity varies greatly, with LC_{50}'s ranging from 0.06 to 50 mg/L.

Metabolism. Following ingestion of this compound, toxicity is produced; the transformation of zinc phosphide (Zn_3P_2) to phosphine gas in the stomach. Phosphine is a highly toxic gas that elicits its effect in the liver and lungs (Schafer 1991a). The phosphine (PH_3) most likely accounts for the acute toxicity of zinc phosphide. Death usually results from asphyxia (USEPA 1980). Studies with radio-labeled ZP indicate that zinc and phosphorous distribute widely in various tissues and blood of rats, although the stomach and intestines contained most of the radioactivity (Matschke and LaVoie 1987). The time between ingestion and death is generally about 30 hours (USEPA 1980).

Primary Toxicity. Acute toxicity studies on 10 species of birds reveal LD_{50} values of less than 50 mg/kg (Matschke and LaVoie, 1987). Birds in particular appear to be sensitive to the emetic effect of zinc phosphide and could regurgitate upon ingestion. Geese appear to be particularly, sensitive with LD_{50} values ranging from 7.5 to 8.8 mg/kg (California Dept. Fish and Game 1962). Reported accidental deaths of geese confirm this susceptibility (Glahn and Lamper 1983; Keith and O'Neil 1964). Several studies suggest that partridges, crowned guinea fowl, and laughing doves reject treated grain if they are provided an alternative food source (Matschke and LaVoie 1987). Hines and Dimmick (in Matschke and LaVoie 1987) fed 25 bobwhite quail treated grain at 10 times the normal application rate in a free-feeding study. After 10 days, 23 of 25 birds survived, indicating the concentrations used were sufficiently high for avian toxicity to occur.

A subchronic lethality dietary study on mallards yielded an LC_{50} of 51.4 mg/kg, almost twice as high as the acute LD_{50} value (Weiss 1986; Hudson et al. 1984). This higher subchronic value indicates that zinc phosphide could be metabolized when ingested over time. Chronic toxicity to the quail was observed in a 20-day dietary test with a LOEL of 0.27 mg/kg-d for reproductive effects (Matschke and LaVoie 1987).

The most sensitive known target mammal is the nutria, with a reported LD_{50} value of 5.6 mg/kg (Matschke and LaVoie 1987). One of the least sensitive mammals, according to available literature, is the desert kit fox (Schitoskey 1975). Hill and Carpenter (1983) note that zinc phosphide is two to 15 times more toxic to rodents than carnivores, with LD_{50} values for rodents ranging from 5.6 to 42 mg/kg and carnivores ranging from 40 to 93 mg/kg. The DWRC performed acute LD_{50} studies on 19 species administered zinc phosphide by gavage (Matschke and LaVoie 1987). All LD_{50} values were below 75 mg/kg (see Table P-11 for a list of species).

In cases of accidental poisonings in humans, acute clinical symptoms include: nausea, abdominal pain, chest tightness, excitability and agitation, and a chilled feeling (Matschke and LaVoie 1987). Later signs and symptoms include shock, dyspnea, thirst, oliguria, convulsions, or coma. In some cases death occurs in the first few hours due to pulmonary edema, but for the majority of human poisonings, death occurs at approximately 30 hours, with cardiac damage the likely contributor to death. Patients that survive the first 3 days after exposure usually recover.

Rodents also appear to sustain the same acute effects as noted for humans (Hill and Carpenter 1982), but occasionally death is prolonged for a few days following poisoning. Liver damage is the primary cause of death in these cases (similar to damage from yellow phosphorus ingestion, indicating accumulative toxic action causing liver damage (USEPA 1980; Hill and Carpenter 1982)). Prolonged exposure to phosphine can produce chronic phosphorus poisoning (USEPA 1980).

Secondary Toxicity. Since zinc phosphide apparently is not stored in muscle or tissues, there is no true secondary toxicity. However, the active ingredient does remain in the gut of animals for several days and could result in secondary poisoning (Hood 1972). Chitty and Southern (in Matschke and LaVoie 1987) reported that of five house cats fed rats that had died from zinc phosphide poisoning, all vomited the rats but two cats still died. However, a variety of studies have also shown that secondary consumers are not likely to suffer intoxication (Bai and Majundar 1984; Hegdal and Gatz 1977b). For example, Hill and Carpenter (1983) fed Siberian ferrets whole rats poisoned with zinc phosphide. The ferrets exhibited emesis, but no other significant signs of toxicity. Hill and Carpenter (1983) speculated that the ferrets were not affected because they avoided poisoning by not ingesting the gastrointestinal tract of the rats. Similar observations have been reported for mongooses, cats, and gopher snakes (Matschke and LaVoie 1987). Evans et al. (1970) found that golden eagles, great horned owls, and coyotes receiving multiple feedings of zinc phosphide poisoned jackrabbits showed no signs of secondary toxicity. Studies investigating secondary hazards to predators demonstrate that red and kit foxes survived at ingestion levels greater than their respective LD_{50} values (Schitoskey 1975).

The secondary poisoning hazards of this compound to organisms appear low because: (1) LD_{50} values are higher for larger animals; (2) the strong emetic effect of zinc phosphide or its common emetic additive (antimony potassium tartrate) reduces hazards to other organisms, especially birds (rodents cannot vomit); (3) scavengers and predators avoid zinc phosphide-contaminated portions (either because of emesis after ingestion or the strong odor of phosphine in the viscera of contaminated animals); and (4) zinc phosphide is not stored in muscle or tissue of treated rodents.

Aquatic. The aquatic toxicity of zinc phosphide is moderate. The most sensitive species (and study) was the bluegill, resulting in an LC_{50} of 0.062 mg/L (H. R. Harkins 1987b). However, another study determined a range of 0.8 to 1.48 mg/L for the same species (Matschke and LaVoie 1987; Hood 1972; Bell Laboratories, Personal communication, 1992). Common LC_{50} values for aquatic organisms range from 0.29 to 0.65 mg/L, respectively, for the carp and rainbow trout.

Benchmark Values. Based on the toxicity of zinc phosphide to both mammals and birds and the potential for significant off-site transport, a thorough analysis was necessary for the QRA. Benchmark values were determined for the three indicator species identified for each formulation, including a bird, a rodent, and freshwater fish. Elemental zinc was considered for chronic aquatic exposures. Surrogate species were then selected based on the available toxicology and similar physiology to the indicator. The benchmarks derived are listed in Table P-23.

For the ring-necked pheasant, acute and chronic studies were available, represented by the pheasant itself and the bobwhite quail. Uncertainty for the pheasant as the surrogate is low because no interspecies variation was required. The sensitivity of the reproductive effect endpoint for the quail also resulted in a low uncertainty factor because the high sensitivity of the endpoint requires little extrapolation. The deer mouse was the mammalian indicator selected and was represented by itself with an acute study and by a rat for estimating chronic toxicity. The chronic study appeared more sensitive than the acute study and should be representative of acute hazards as well. The acute deer mouse study indicated sensitivity similar to some rat studies, indicating little interspecies variation between the two rodents (see Table P-11).

The cumulative UF value (assigned to the pheasant) for acute hazards was 6 because of no interspecies variability, which yielded a benchmark value of 1.47 mg/kg. A UF of 10 was used for the chronic benchmark to account for extrapolation from quail to pheasant, but with a more sensitive endpoint. The chronic benchmark was determined to be 0.03 mg/kg-d. The uncertainty for acute exposures to the deer mouse were calculated to be 90, resulting in an acute benchmark of 0.47 mg/kg. The cumulative UF value for chronic exposure was 6, yielding a final benchmark of 0.58 mg/kg-d. The surrogate for freshwater fish was the most sensitive aquatic species found, the bluegill, and was assigned a UF of 18, resulting in an acute benchmark of 0.0034 mg/L. A chronic benchmark was determined for elemental zinc remaining in the water body. The Ambient Water Quality Criteria Final Chronic value is 0.058 mg/L, which did not require any additional uncertainty factors (see Table P-23).

ae. Zinc Phosphide Concentrate for Mouse Control, 63 percent

(1) Use Pattern

Zinc phosphide concentrate is registered by APHIS ADC for mouse control. The formulation was applied to control marmot damage in rural areas of Idaho under a State experimental use permit between FY 1988 and 1991. Only one APHIS ADC employee applied this formulation. The State EUP was necessary because the target species (marmots) differed from the targets listed on the current label (mice). The bait was placed above ground in rocky outcrop areas along the edges of pastures, crops, or orchards to reduce damage caused by the target species to crops and pastures (Worthen, M., Personal communication, April 1992). The formulation was used at a maximum rate of 4 g per quart of bait, with a maximum of 4 pounds of concentrate (2.5 pounds a.i.) used in a single year during FY 1988 through 1991. The formulation was used primarily during spring.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Zinc phosphide concentrate, was used to control damage by marmots is placed above ground in rocky outcrop areas along the edges of pastures, crops, or orchards (Worthen, M., Personal communication, April 1992).

Primary Nontarget Hazards. Any animals likely to consume zinc phosphide-treated bait applied along crop edges could be affected by use of this formulated product. Potential nontarget receptors where this formulated product was applied in Idaho included deer mice, ground squirrels, voles, rabbits, and deer (Worthen, M., Personal Communication, April 1992).

Secondary Nontarget Hazards. Zinc phosphide breaks down rapidly in the gastrointestinal tract of affected animals and presents little secondary hazard to predators or scavengers unless the gut contents are ingested and unassimilated zinc phosphide is still present.

Domestic Animals. One domestic horse was accidentally killed by eating zinc phosphide bait placed along crop edges in Idaho. The death resulted from a misunderstanding between the landowner and the APHIS ADC employee regarding when and where the baiting would occur (Worthen, M., Personal communication, April 1992). Other domestic livestock would also be affected by this formulated product if they are exposed to bait and consume it.

Threatened and Endangered Species. Two listed species occurring in Idaho, the whooping crane and woodland caribou, would potentially be affected from consumption of zinc phosphide concentrate. Use of zinc phosphide concentrate is not specifically restricted within the range of these two species. No listed species would be affected by secondary hazards resulting from consumption of zinc phosphide-poisoned prey.

(3) Screening

This formulation of zinc phosphide concentrate as used for marmots, received a cumulative score of 50. The formulation scored comparatively high because of potential exposure to two threatened and endangered species and the high chronic and acute toxicity of the active ingredient.

(4) Exposure Assessment

Indicator Species and Exposure Factors. Exposures to these formulations were represented by the deer mice and freshwater fish, as detailed in the representative scenario for zinc phosphide.

(5) Risk Characterization

Primary. Results of the analysis for deer mice presented in Table P-27 suggest evidence of toxic acute exposures based on ingestion of bait, supported by an acute HQ value of 1,200. The chronic hazards are also significant, with HQ value of 551. These HQ values are smaller than those determined for the representative scenario, which results from a concentration of only 0.7 percent in the formulated bait as placed in the field.

Application of zinc phosphide-treated concentrate baits to control marmots may pose risks to the whooping crane. This listed species migrates through Idaho and is known to forage on plants as well as grains and arthropods. The whooping crane could be affected by consumption of zinc phosphide concentrate baits applied within its range during spring or fall migration. The woodland caribou would not be affected because this species does not occur within the range of areas damaged by marmots in Idaho (Connolly, G., Personal communication, July 1992).

Secondary. No calculations were performed for this pathway because zinc phosphide literature suggests that secondary toxicity is generally of a low order because of the lack of accumulation in muscle and tissue.

Aquatic. Exposure of zinc phosphide to the aquatic environment is assumed to be addressed by the representative scenario for muskrat/nutria control.

(6) Conclusions

Primary Toxicity. There is potential risk to the indicator species (deer mouse), based on elevated HQ values for both acute and chronic exposures. There is potential risk to the whooping crane if this species consumes bait applied within its range during spring or fall migration. No probable risk is expected for the woodland caribou because it does not occur within the range of areas damaged by marmots in Idaho.

Secondary Toxicity. No probable risk is expected, based on low secondary toxicity of zinc phosphide.

Aquatic. No probable risk is expected, based on low HQ value accompanied by significant degradation over time, as indicated by the representative scenario results.

(7) Comparison of Findings with Those of USFWS and USEPA

This formulated product was not specifically addressed in USFWS's Biological Opinions or USEPA's Request for Section 7 Consultation.

af. Zinc Phosphide Concentrate for Muskrat and Nutria Control, 63 percent

(1) Use Pattern

This zinc phosphide concentrate formulation is used for the control of muskrats and nutria and is applied on bait cubes in rafts located in bayous, swamps, and canals. Resources protected from muskrat and nutria damage include property, pets, and natural resources. The material is federally registered by APHIS ADC and was used in three States (LA, TN, TX) between FY 1988 and 1991. The maximum application rate is 10 pounds of bait (0.6 percent a.i.) per raft placed no closer than 50 feet. The maximum yearly quantity of a.i. used was 1.7 pounds in Texas. The formulation was used throughout the year by a total of 10 APHIS ADC employees in the three States, on both urban and rural land. The formulation was also used on both public (Tennessee) and private land (Louisiana and Texas).

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. This zinc phosphide concentrate is used to control damage by muskrats and nutria and is applied to food baits that are placed on rafts located in bayous, swamps, and canals.

Primary Nontarget Hazards. Beavers and raccoons are the only species likely to be affected by the consumption of zinc phosphide bait on rafts. Specific bait applications are designed to minimize nontarget hazards (Evans 1970). Bait pieces are cut in 1 to 2 inch pieces, which were designed to be too large for waterfowl to consume.

Secondary Nontarget Hazards. Zinc phosphide presents minimal secondary hazard to predators and scavengers. Zinc phosphide is an emetic, so such meat-eating animals as mink, cats, dogs, and raptors could regurgitate poisoned nutria or muskrats with little or no effect. Alligators cannot regurgitate, but appear to be relatively protected from potential poisoning because only a very large dose would be fatal to an alligator.

Domestic Animals. Domestic cats and dogs are susceptible to secondary poisoning if they consume zinc phosphide-poisoned prey. One domestic cat and one domestic dog were killed after they were fed the stomach contents of poisoned nutria during a lab study (Evans, Pers. comm. cited in Hood 1972).

Threatened and Endangered Species. No threatened or endangered species occurring in Louisiana and Tennessee would be affected by use of this formulated product.

(3) Screening

The concentrate formulation for muskrats and nutria received a cumulative score of 35, with most of the score (19) resulting from the toxicity component. There were few nontarget receptors and no hazards to threatened or endangered species based on the use of the compound on rafts. Along with the high toxicity, and the potentially sensitive aquatic ecosystem, the score of 35 warranted further investigation through QRA.

(4) Exposure Assessment

Indicator Species and Exposure Factors. Exposure to this end-use formulation is represented by the deer mice, as detailed in the representative scenario for zinc phosphide, and for freshwater fish for potential aquatic exposures. No exposure factors are required for determining exposure to fish because they are exposed to concentrations directly related to the measured toxic water concentration.

Aquatic Exposure Assessment. Zinc phosphide for muskrat and nutria control was selected as the representative scenario for developing EECs in surface water. The scenario used assumed that the raft capsized via a storm or other disruptive event and disperse the

material into the water. The maximum application rate for the formulation specified in the label is 10 pounds of bait per raft (30.24 grams of a.i.). The maximum application frequency used by APHIS ADC between FY 1988 and 1991 was twice per year, with a second application possible one month following the first application (LeBlanc D., and McEwen, G., Personal communication, April 1992). It is assumed for the model that 30.24 grams of zinc phosphide is dispersed from the raft into the same hypothetical pond as used for EXAMS modeling. It is further assumed that zinc phosphide was immediately mixed within the water column and maintained at homogeneous concentrations. Zinc phosphide can be decomposed to phosphine gas and ionized zinc. The maximum zinc phosphide available to generate phosphine gas in the pond would therefore be 0.0041 mg/L. Accordingly, a total of 0.0031 mg/L of ionized zinc would be released into the pond following each application due to zinc phosphide decomposition.

MINTEQA2 modeling was conducted for estimating EECs of ionized zinc in the water column of the hypothetical pond. The total suspended solid concentration in the water column was assumed to be 30 mg/L (same as EXAMS model). The specific surface area for the suspended solids was assumed to be 600 m^2/g and to entail an absorbing surface consisting of two sites with assumed site densities (Allison, Personal communication, May 1992). It was further assumed that the pond water was pH-neutral.

Results for the Quantitative Exposure Assessment. As discussed in the above section, the maximum zinc phosphide concentrations in surface soil and water were 1.38 mg/kg and 0.0041 mg/L, respectively. The dissolved ionized zinc concentration in the pond, modeled by MINTEQA2, was 0.0004 mg/L at equilibrium. These outputs were also discussed in the MINTEQA2 sensitivity analysis.

(5) Risk Characterization

Primary. The calculated results from the mouse control concentrate formulation previously addressed are expected to represent potential exposures to this formulation. No listed species, however, are expected to be affected because they are unlikely to consume bait placed on rafts.

Secondary. No calculations were performed for this pathway because zinc phosphide literature suggests that secondary toxicity is generally of a low order.

Aquatic. Preliminary results based on expected surface water concentrations for acute exposures (based on zinc phosphide) and chronic exposures (based on elemental zinc) to freshwater fish indicate little apparent hazard. The corresponding HQ for acute aquatic exposures was estimated at 0.4, based on a maximum short-term zinc phosphide water concentration of 0.0041 mg/L. Chronic exposures were calculated based on the presence of elemental zinc in the water column because of the rapid release of phosphine (and subsequent dissociation from zinc) when released in water (see more detailed discussion of environmental fate of zinc phosphide, p. P-254). The chronic HQ for zinc was calculated to be 0.01, based on the national final chronic value determined by the USEPA Office of Water Regulations and Standards (USEPA 1987b) and a modeled zinc concentration (MINTEQA2) of 0.0004 mg/L.

(6) Conclusions

Primary Toxicity. Potential effects are expected for both acute and chronic oral exposures (both avian and mammalian species), based on high oral HQ values found for the mouse concentrate formulation. No probable risk is expected for listed species because none are likely to consume bait placed on rafts.

Secondary Toxicity. No probable risk is expected, based on low secondary toxicity of zinc phosphide.

Aquatic. No probable risk is expected, based on low HQ value accompanied by significant degradation over time.

(7) Comparison of Findings with Those of USFWS and USEPA

This formulated product was not specifically addressed in USFWS's Biological Opinions or USEPA's Request for Section 7 Consultation.

(8) Mitigation

No mitigation is necessary to protect listed species because none are likely to be affected by use of this formulated product. Investigating dens prior to application in accordance with the label is sufficient.

ag. Zinc Phosphide Concentrate for Rat Control, 63 percent

(1) Use Pattern

The zinc phosphide concentrate formulation for control of commensal rodents (black rats and Norway rats) was used in five States (NE, NM, TX, WV, VA) between FY 1988 and 1991. Approximately eight APHIS ADC employees applied this restricted use formulation in these five States. The bait was placed in buildings and storage areas to protect grain, feed, and livestock from damage caused by rats. Texas used the most active ingredient (0.47 pounds a.i.), and Virginia and Nebraska used the least (0.08 pound a.i.) during the target years. The maximum allowable application rate is one rounded teaspoon of 1.5 percent formulated bait (approx. 4 to 5 g of bait with 0.08 g a.i.) every eight to 10 feet. This rate has a minimum time between applications of one month. According to the label, all uneaten bait and carcasses are to be collected and disposed of 72 hours after application. The rat control formulation was used throughout the year statewide, on both urban and rural private land.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. Zinc phosphide concentrate for rat control is applied in rat burrows and in and around houses and buildings where commensal rodents are found. In Texas, this formulated product was also used in enclosed barns (Hobbs, J., Personal communication, April 1992).

Primary Nontarget Hazards. Any animals likely to consume zinc phosphide-treated bait could be affected by use of this formulated product. However, potential hazards to most nontarget receptors are minimal, because zinc phosphide has an odor attractive to rodents but repulsive to most other animals and zinc phosphide is an emetic, which rats are unable to regurgitate, whereas other nontarget animals can regurgitate the bait with little or no effect. Nontarget hazards are also minimized by the placement of bait in tamper-proof boxes in and around houses and buildings.

Secondary Nontarget Hazards. Zinc phosphide generally presents minimal secondary hazard to predators and scavengers. However, domestic cats and dogs are susceptible to secondary poisoning (see **Domestic Animals**, below).

Domestic Animals. Domestic animals likely to consume zinc phosphide bait could be affected by application of this formulated product. Domestic cats and dogs are also susceptible to secondary poisoning. Several cats were killed when they were fed zinc phosphide-poisoned rats during a lab study (Chitty and Southern 1954 in Hood 1972). One domestic cat and one domestic dog died from consuming the stomach contents of zinc - phosphide-poisoned nutria during another lab study (Evans Personal Communication in Hood 1972). Three domestic dogs were killed after zinc phosphide rice bait was applied in rice fields to control rodents in Thailand (Tongtavee et al. 1987 in Johnson 1991a).

Threatened and Endangered Species. No threatened or endangered species occurring in the range of use of this formulated product would be affected by application of this zinc phosphide concentrate. The whooping crane occurs within the range, but it is unlikely to occur near houses or barns where the bait is applied. The bald eagle and peregrine falcon also occur within the range of use of this formulated product, but would not be affected because secondary hazards resulting from consumption of zinc phosphide-poisoned prey are minimal.

(3) Screening

The formulation for control of commensal rodents received a cumulative score of 34, with the majority of the score (19 points) resulting from the high toxicity of the active ingredient. The score was below the threshold value of 35, and further quantitative evaluation of this formulation was not recommended, primarily from the lack of hazards to threatened or endangered species. The use of this product in and around buildings in tamper-proof boxes virtually eliminated the potential exposure of listed species to this formulation.

(4) Documentation of Results

Primary Toxicity. No probable risk, based on the screening process, because few nontarget species and no listed species are likely to consume baits applied near houses or barns to control commensal rodents.

Secondary Toxicity. No probable risk expected, based on low secondary toxicity.

Aquatic. No probable risk expected, based on the low HQ and significant degradation over time from the representative scenario (ZP for muskrat and nutria control).

ah. Zinc Phosphide (ZP Rodent Bait AG, D&H Formula Rodent Rid-R, Steam-Rolled Oats, ZP Rodent Bait), 2 percent; and Zinc Phosphide on Wheat, 1.82 percent

(1) Use Pattern

Zinc Phosphide (ZP rodent bait AG), 2 percent. This formulated product consist of oats containing 2 percent zinc phosphide and was applied in North Dakota during the target years. This formulation is registered by Bell Laboratories and restricted for use to certified applicators only. This end-use formulation was used by APHIS ADC for the control of damage to grain crops caused by ground squirrels. The maximum annual use in North Dakota was 2 pounds (0.04 pounds a.i.) on rural, private land statewide. The maximum application rate is 20 pounds/acre with only one application per year. This formulation was applied during the summer and fall by one APHIS ADC employee.

Zinc Phosphide, D&H Formula Rodent Rid-R, 2 percent. This end-use formulation was used in Oregon during FY 1988 to FY 1991. The D&H bait is commercially registered for use against ground squirrels, pocket gophers, and voles for the protection of pastures and burrowing damage. The maximum amount used was 6,675 pounds of prepared bait (133.5 pounds a.i.). The maximum application rate is 10 pounds/acre, applied at a frequency of once a year for a site. The majority of use occurred during the spring. This product is a restricted use pesticide, with approximately eight APHIS ADC employees involved in the application. Because of its restricted use, the label requires that uneaten bait be picked up and carcasses removed daily.

Zinc Phosphide on Steam-Rolled Oats, 2 percent. This formulation is federally registered under several labels as a restricted use pesticide by the APHIS ADC program for the control of damage to rangelands, crops, pastures, and turf from prairie dogs. The formulation also was used in 1990 in Vermont under an experimental use permit for control of chipmunks, mice, and squirrels to field-test its potential to protect maple sap tubing. Four other States (NE, ND, NM, OK) used the 2 percent oat bait between FY 1988 and 1991,

primarily on private land in rural settings. The maximum annual use of this formulation was greatest in Nebraska, at 16,922 pounds (338 pounds a.i.), but was less than 1,000 pounds in the other four States. The maximum application rate was 10 pounds/acre and 4 g/placement at a frequency not to exceed one application each year. The compound was used throughout the year by a total of 23 APHIS ADC or APHIS ADC-supervised employees.

Zinc Phosphide (ZP Rodent Bait), 2 percent. This end-use formulation contains 2 percent zinc phosphide in the form of easily applied pellets and was used in New Mexico. This product is registered by Bell Laboratories and commercially available to anyone. The product was used by APHIS ADC for the control of damage caused by kangaroo rats to pastures, rangelands, dikes and property. The maximum annual use was 595 pounds (11.9 pounds a.i.) on rural, private land statewide in New Mexico. The maximum application rate is two teaspoons per placement, with only one application per month at a site. This product was applied during the spring, and summer by approximately six APHIS ADC or APHIS ADC-supervised employees.

Zinc Phosphide on Wheat, 1.82 percent. This formulation is federally registered by the APHIS ADC program as a restricted use pesticide for the control of damage caused by voles and house mice. The formulation is used for the protection of fruit crops and property and for human health and safety concerns. The 1.82 percent wheat bait was applied in three States (KY, OR, and TN) between FY 1988 and 1991 by approximately 10 APHIS ADC or APHIS ADC-supervised employees, primarily on private land, both urban and rural. The maximum annual use was 600 pounds (11 pounds a.i.) in Nebraska. The rate of application is specified on the label not to exceed 10 pounds per acre at a maximum frequency of once per year. The compound was used year-round.

(2) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. The 1.82 percent and 2 percent formulations of zinc phosphide are applied in a variety of habitats, including rangeland, orchards, pastures, along ditches, on dikes, and adjacent to buildings. These formulations are used to control damage by prairie dogs, voles, deer mice, ground squirrels, pocket gophers, mice, and kangaroo rats. Zinc phosphide oat bait has also been applied experimentally in sugarbushes to protect maple sap tubing from chipmunks, deer mice, flying squirrels, red squirrels, and gray squirrels.

Primary Nontarget Hazards. Any granivorous birds and mammals occurring in the areas where zinc phosphide grain bait is applied could be affected by use of these formulations. Nontarget birds that were killed as a result of field applications of zinc phosphide grain baits include eight ring-necked pheasants, five vesper sparrows, two northern cardinals, two mallards, two bitterns, one horned lark, one blue jay, and one snipe (Collins 1966 in Johnson 1991a ,b; Pank et al. 1975, 1976c; Hegdal and Gatz 1977b; Matschke et al. 1978 in Johnson 1991a ,b; Record and Swick 1983 in Johnson 1991a ,b; Holbrook and Timm 1985). Nontarget mammals that were killed included nine cottontail rabbits, seven deer mice, two pocket gophers, two white-tailed jackrabbits, one ground squirrel, and one northern grasshopper mouse (Hegdal and Gatz 1977b; Matschke et al. 1978 in Johnson 1991a ,b; USFWS 1979 in Johnson 1991a ,b; Barnes et al. 1982). Studies also indicated reduced numbers of deer mice, house mice, meadow jumping mice, and ground squirrels following application of zinc phosphide grain bait in Michigan and South Dakota (Hegdal and Gatz 1977b; Uresk et al. 1986).

Additional nontarget animals that were present in the baited areas but apparently unaffected included mallards, killdeer, flickers, mourning doves, crows, magpies, blackbirds, robins, sparrows, juncos, and meadowlarks (Hegdal and Gatz 1977b; Matschke et al. 1983; Uresk et al. 1986). However, any of these additional nontarget species could have been affected, because zinc phosphide is a relatively slow-acting toxicant, and affected animals may move considerable distances from baited areas before dying (Hegdal and Gatz 1977b).

Application of zinc phosphide baits in California resulted in the death of 455 nontarget geese, including 325 white-fronted geese, 103 cackling geese, 25 snow geese, and two Canada geese (Keith and O'Neill 1964). Zinc phosphide baits were originally applied in barley fields to reduce damage by voles. The fields were burned 3 months after treatment, which exposed large amounts of unconsumed bait to geese. Large numbers of geese were observed feeding in the field shortly after it was burned, and more than the 455 dead geese may have been affected.

High numbers of nontarget deaths were reported following statewide applications of zinc phosphide bait in Michigan. These nontarget deaths included 30 Canada geese, 25 snow geese, 24 wild turkeys, 10 gray squirrels, and one black squirrel (USEPA 1988e). Other potentially affected species in Michigan included rabbits and deer. Because of its slow-acting toxicity, the authors report that larger numbers of nontarget animals may have been killed but not found in the vicinity of the bait application. However, these nontarget deaths resulted from inappropriate applications of zinc phosphide, including overfilling and spillage of bait, lack of proper construction and maintenance of feeders, improper broadcast applications, and use of a bait (usually cracked corn) that is attractive to a variety of nontarget animals (USEPA 1988e).

Secondary Nontarget Hazards. Results of laboratory studies generally indicate that zinc phosphide poses little secondary risk to nontarget wildlife (Johnson 1991a, b). Zinc phosphide breaks down rapidly in the digestive tract of affected animals, so predators and scavengers are generally not exposed to the compound. Species that were fed zinc phosphide-poisoned prey during lab studies and were apparently unaffected included Siberian ferrets, mongooses, coyotes, kit foxes, mink, black vultures, bald eagles, golden eagles, and great horned owls (Doty 1945 in Hood 1972, Evans et al. 1970 in Hood 1972; Bell and Demminck 1975; Schitoskey 1975; Hill and Carpenter 1981). Secondary hazards generally were reduced during these studies because the animals regurgitated poisoned prey or refused to eat poisoned prey, particularly when alternative food sources were available.

Zinc phosphide effects on domestic dogs and cats are more variable. Domestic pets are more susceptible than other animals, particularly if they consume the digestive tract of affected prey, which could contain unmetabolized zinc phosphide for several days. Evans (1965 in Johnson 1991a, b) tested the effects of zinc phosphide secondary poisoning on domestic dogs and cats. One dog died after consuming the stomach contents of a zinc phosphide-killed nutria, while two other dogs that ate nutria stomachs regurgitated and survived. Two additional dogs consumed muscle tissue, livers, lungs, stomachs, and intestines of nutria killed with zinc phosphide for five months without showing any ill effects. Of five cats fed a mixture of meat from unpoisoned nutria and stomach contents from poisoned nutria, one died, two regurgitated, and two others displayed no symptoms of intoxication. Chitty (1954 in Johnson 1991a, b) fed zinc phosphide-poisoned rats to six cats. Five cats ate the rats, and although all five later regurgitated the rats, two of the cats died.

Several incidents of secondary hazards were reported following field applications of zinc phosphide baits: three domestic dogs were killed after rice bait was applied in fields to control rodent damage in Thailand (Tongtavee et al. 1987 in Johnson 1991a, b) and one red fox was killed from eating poisoned mice that had consumed treated grain in Michigan (USEPA 1988e). During other field studies, predatory birds and mammals were observed foraging on poisoned prey, with no apparent secondary effects. These animals included American crows, common ravens, turkey vultures, and black-billed magpies feeding on poisoned jackrabbits (Griffith 1972 cited in Johnson 1991a, b) coyotes and badgers feeding on prairie dog carcasses (Tietjen 1976 cited in Johnson 1991a, b) and barn owls and the endangered Hawaiian hawk feeding on poisoned rats (Pank et al. 1975).

Domestic Animals. Domestic livestock would potentially be affected by consumption of zinc phosphide-treated oats if bait is placed in areas accessible to foraging livestock. Hazards to domestic cats and dogs are described above under secondary hazards.

Threatened and Endangered Species. Two listed species, the whooping crane and Aleutian Canada goose, would potentially be affected by consumption of zinc phosphide-treated grains. Use of zinc phosphide is specifically prohibited by the label within critical habitat areas of the whooping crane, but not all stopover areas used by migrating whooping cranes are designated critical habitat. The bald eagle and peregrine falcon also occur within the range of use of these formulations, but would not be affected because the likelihood of secondary hazards from zinc phosphide is very low.

(3) Screening

The 2 percent formulations of zinc phosphide received cumulative scores of 51 and 47 for the oats and baits (three formulations combined) and the D&H formula, respectively. The 1.82 percent formulation received a cumulative score of 50 (see Table P-14). The key areas supporting the designation warranting QRA for these formulation were: (1) the acute and chronic toxicity for the active ingredient; (2) the presence of potentially exposed threatened and endangered species; and (3) the high quantity of use and application rates of the formulations.

(4) Exposure Assessment

Indicator Species and Exposure Factors. The ring-necked pheasant and deer mouse were selected as the indicator species to address primary toxicity of zinc phosphide. Although the ring-necked pheasant is a non-native species, it is valued as an upland game bird in North America. The ring-necked pheasant is potentially exposed to zinc phosphide because it inhabits areas where the bait may be applied, and its diet includes grains and seeds, particularly during fall and winter. These potential exposures and sensitivity of the selected organism are further supported by empirical observations: two ring-necked pheasants were found dead after application of cracked corn in orchards to control voles (Hegdal and Gatz 1977b) and after application of zinc phosphide bait along ditches to control Norway rats (Collins 1966 cited in Johnson 1991b).

Selection of the deer mouse as a sensitive indicator species is supported also by empirical data: reduced population levels of deer mice were reported following application of bait to control voles in Michigan (Hegdal and Gatz 1977b) and prairie dogs in South Dakota (Uresk et al. 1986).

Exposure Factors. The ring-necked pheasant is potentially exposed through primary ingestion of bait. The ingestion rate of the pheasant was assumed to be approximately five percent of its body weight (57 g/d) (Kenaga 1973). The percentage of diet potentially contaminated with zinc phosphide is 50 percent, comprised entirely of grain. The 4-acre home range of the pheasant is assumed to lie within the entire application area. Potential exposure factors determined for the deer mouse are similar to those described above for strychnine.

(5) Quantification of Exposure

Key Assumptions and Modeling Procedures. Seven of the eight zinc phosphide formulations used by APHIS ADC in more than 15 States warranted QRA, based on the screening and scoring process. Six of these formulations are applied on the ground, and one (zinc phosphide for Muskrat and Nutria Control) is applied on floating rafts. ZP Rodent Bait AG (2 percent) was selected as the representative scenario for estimating surface soil zinc phosphide EECs, based on the criteria stated above. This simulation was based on application in ND to protect grain crops (see Table P-18). The maximum label-specified application rate allows 20 pound/acre (2 percent), which represents the highest rate (of the a.i.) among the six ground-applied formulations.

PRZM modeling is not appropriate for zinc phosphide; zinc phosphide EECs in surface soil were estimated using a simplified conservative algorithm, assuming that the 20 pounds/acre (2 percent) of ZP Rodent Bait AG was applied to the soil surface. This yielded a maximum concentration in the upper 2 cm of surface soil of 1.38 mg/kg.

Results for the Quantitative Exposure Assessment. As discussed in the above section, the maximum zinc phosphide concentrations in surface soil and water were 1.38 mg/kg and 0.0041 mg/L. Dissolved ionized zinc concentration in the pond modeled by MINTEQA2 was 0.0004 mg/L at equilibrium. These outputs were also discussed in the MINTEQA2 sensitivity analysis.

(6) Risk Characterization

Primary. Results of the analysis for the ring-necked pheasant suggest evidence of highly toxic acute exposure, based on ingestion of grain bait supported by an acute HQ value of 341 for the representative scenario. The results listed in Table P-27 indicate greater toxicity, based on chronic exposures to 2 percent AG formulation, as indicated by a hazard quotient of 10,560, significantly greater than the acute HQ value. These elevated values were based primarily on: (1) high orders of both acute and chronic toxicity to nontarget organisms; and (2) high concentrations in bait (20,000 mg/kg) at the time of application, with only 57 percent estimated degradation within 10 days (Matschke and LaVoie 1987). The significant difference in the acute and chronic HQ values is due in part to the greater chronic toxicity and lack of significant environmental degradation. In addition to primary ingestion of bait, the incidental soil ingestion pathway for the ring-necked pheasant contributed insignificantly to the cumulative HQ, with a soil HQ of less than 0.01.

Results for ingestion of baits by the deer mouse also suggest evidence of elevated acute and chronic toxicity, supported by acute and chronic HQ values of 3,640 and 1,670, respectively. The chronic toxicity does not appear to warrant as much concern as for the avian species (pheasant), which is explained by greater susceptibility of avian species to zinc phosphide. The only evidence of any contribution from the incidental soil ingestion pathway for zinc phosphide was with the deer mouse. A HQ value of 0.03 for acute exposures was calculated, indicating no potential hazards from soil. This small value is also up to five orders of magnitude less than the final chronic HQ of 3,600.

The limited ranges of the ring-necked pheasant and deer mouse (approximately 4 and 0.5 acres, respectively) assume 100 percent exposure at all times. These calculations also assume that the entire daily ingestion rate (56 and 4.6 g/day, respectively) occurred at the application site and consisted exclusively of zinc phosphide-treated bait.

Results of the quantitative risk assessment for the deer mouse and ring-necked pheasant indicate that primary hazards are likely to occur for other nontarget animals for all of the formulations indicated above. Hazards are highest to granivorous birds and mammals feeding in areas where zinc phosphide bait is applied. Nontarget hazards have been specifically reported for Canada geese, mallards, pheasants, blue jays, horned larks, cardinals, and sparrows as well as for rabbits, deer mice, pocket gophers, jackrabbits, ground squirrels, and grasshopper mice.

Primary hazards from zinc phosphide grain bait potentially exist for one listed species, the Aleutian Canada goose, occurring within the range of use of this compound. The Aleutian Canada goose occurs along the Oregon coast during spring and fall migration and could be adversely affected by consumption of zinc phosphide grain bait if the compound is applied within its limited range during spring or fall. The whooping crane also occurs within the range of use of this compound, but would not be affected because application of zinc phosphide grain bait is specifically restricted by the label within the range of this species.

Secondary. No calculations were performed for this pathway because zinc phosphide literature suggests that secondary toxicity is generally of a low order.

Aquatic. Preliminary results based on expected surface water concentrations for acute exposures (based on zinc phosphide) and chronic exposures (based on elemental zinc) to freshwater fish indicate little apparent hazard. The representative scenario (muskrat and nutria) is assumed to represent aquatic hazards for this formulation.

(7) Conclusions

Primary Toxicity. Potential risk may be expected for both acute and chronic oral exposures (both avian and mammalian species), almost exclusively based on expected concentration and high susceptibility to bait formulations. Potential risk may be expected to the Aleutian Canada goose if this species consumes zinc phosphide grain bait applied within its range in Oregon during spring or fall migration. No probable risk to the whooping crane because application of zinc phosphide grain bait is specifically restricted by the label within the range of this species.

Secondary Toxicity. No probable risk expected, based on low secondary toxicity of the a.i.

Aquatic. No probable risk expected, based on the low HQ and significant degradation over time from the representative scenario (ZP for muskrat and nutria control).

(8) Comparison of Findings with Those of USFWS and USEPA

USFWS, USEPA, and the risk assessment concluded that the Aleutian Canada goose could be adversely affected by consumption of zinc phosphide-treated grain bait (USEPA 1991b; USFWS 1992). USFWS further concluded that the APHIS ADC program will not jeopardize the continued existence of the Aleutian Canada goose, although the APHIS ADC program has the potential to cause incidental take (USFWS 1992).

USFWS and USEPA both concluded that the whooping crane also could be adversely affected by consumption of zinc phosphide-treated grain bait (USEPA 1991b; USFWS 1992). This differs from the conclusion of the risk assessment that the whooping crane would not be affected because use of zinc phosphide grain baits is specifically prohibited by the label within the range of this species. However, USFWS adds that the APHIS ADC program's restrictive use of these chemicals limits their effects on the whooping crane and that the APHIS ADC program is not likely to jeopardize the continued existence of this species (USFWS 1992).

(9) Mitigation

USFWS established the following reasonable and prudent measures to minimize potential impacts to the Aleutian Canada goose: (1) prohibit use of zinc phosphide within known or likely habitats of the subspecies in nine California counties and three Oregon counties; and (2) submit proposals to use Avitrol on the subspecies' breeding grounds to the Anchorage USFWS Regional Office for review and approval (USFWS 1992).

ai. Bone Tar Oil (Magic Circle Deer Repellent), 93.75 percent

(1) General Discussion

Bone tar oil was used as an area odor repellant (to deer) in New Hampshire between FY 1988 and 1991. The product was used to protect trees, shrubs, and other plant material from damage from deer. The material, a dark, viscous liquid produced by the destructive distillation of animal bones, is relatively nontoxic and used only as a repellant, resulting in no risk to target or nontarget animals.

(2) Critical Element Screening

Based on the above discussion, there is very little likelihood that this compound could contribute to nontarget effects. The low toxicity, LD10 of 500 mg/kg for humans and 800 mg/kg for rats, is the main factor indicating the potential for no nontarget effects. Accordingly, it was eliminated from further consideration, based on the criteria presented below.

(3) Documentation of Results

Primary Toxicity. No probable risk is expected based on the critical element screening because the formulated product is relatively non-toxic.

Secondary Toxicity. No probable risk is expected, based on the critical element screening because the formulated product is relatively non-toxic.

Aquatic. No information available for this product.

aj. Sodium Cyanide — NaCN; CAS #143-33-9

(1) M-44 Cyanide Capsules, 88.62 percent

(a) General Discussion

Sodiumcyanide is used for many purposes, including agricultural, pharmaceutical, and industrial dyes and as an insecticide and predacide. This specific end-use formulation of the toxicant is contained in 1-inch, 0.44-inch in diameter plastic capsule that is used in the M-44 ejector mechanism. When pulled the spring-activated ejector ejects the dry NaCN mixture into the mouth of the target species, causing death through the inhalation of the toxic fumes. When in contact with moisture, sodium cyanide releases hydrogen cyanide, the actual toxicant.

(b) Use Patterns

This formulation was developed and registered for use by the APHIS ADC program for the control of coyote depredation on livestock. This formulation was used in 17 States (AZ, CA, CO, ID, LA, MT, ND, NE, NM, NV, OR, OK, SD, TX, UT, WY, and WA) between FY 1988 and 1991. The maximum annual use was 47,100 capsules (84 pounds a.i.) in Texas. The maximum density of M-44 placement is 10 devices per 100 acres. The M-44s are checked weekly or more frequently. This product is used mostly in the winter and spring, but it is used throughout the year in some locations.

(c) Habitat Types and Potentially Exposed Nontarget Species

Habitat Types. M-44 capsules are used in rangeland for the control of canid, primarily coyote, depredation on livestock. The capsules are placed along game trails, livestock trails, and ridges and near seldom-used ranch roads and along fencelines.

Primary Nontarget Hazards. M-44s are placed in rangeland and baited with olfactory attractant to attract coyotes, foxes, and feral dogs. Any other animals occurring in rangeland that are attracted to the scent and that are likely to activate the ejector device could be affected by use of this product. Small animals, however, commonly set off the device without ill effect because their mouths are not positioned above the capsule at the instant of ejection. During FY 1988, a total of 942 nontarget animals were killed as a result of activating M-44 ejectors (see Appendix H).

This total included 272 skunks, 216 domestic dogs, 145 raccoons, 118 opossums, 62 gray fox, 55 kit fox, 28 bobcats, 13 swift fox, 11 ringtail cats, 8 vultures, 6 badgers, 4 black bear, 4 crows, 3 peccaries, 2 porcupines, 2 ravens, 2 feral hogs, and 1 domestic cat.

In addition to the nontarget kills, a total of 15,053 target animals were also killed, including 13,682 coyotes, two feral dogs, 386 gray foxes, and 983 red foxes (see Appendix H). Thus, the 942 nontarget animals represented approximately six percent of the total animal kill resulting from M-44 use by APHIS ADC personnel in FY 1988.

Secondary Nontarget Hazards. No secondary poisoning results from use of sodium cyanide capsules.

Domestic Animals. As noted above, 216 domestic dogs and 1 domestic cat were killed as nontargets by M-44s in FY 1988. One domestic calf was also killed between 1974 and 1975 (Matheny 1976).

Threatened and Endangered Species. Six listed species would potentially be affected by use of sodium cyanide capsules if they occur in rangeland where this product is applied:

- California condor
- San Joaquin kit fox
- Jaguarundi
- Ocelot
- Gray wolf
- Grizzly bear

One immature California condor was apparently killed by activating an M-44 device on November 23, 1983, in Kern County, CA (USFWS 1992).

None of these listed species are specifically mitigated for in the label for this formulated product. However, the label states: "The M-44 ejector device cannot be used in areas inhabited by endangered canids and felids. The M-44 device shall not be used in areas where federally listed threatened or endangered animal species might be adversely affected. Each applicator shall be issued a map, prepared by or in consultation with USFWS, which clearly indicates such areas."

(d) Environmental Fate

Sodium cyanide is instantly soluble in water and therefore is likely to be highly mobile in soils. Alkali metal salts of cyanide, which include sodium cyanide, are readily soluble and separate into individual ionic species on dissolution. Sodium cyanide also reacts with acids and decomposes when exposed to moisture, producing hydrogen cyanide gas. It is a fumigant when activated and is used in the open atmosphere, and persistence in the environment is not a concern because of rapid degradation releasing hydrogen cyanide to the atmosphere (Schafer 1990b). Sodium cyanide is stable under dry conditions. Atmospheric hydrogen cyanide eventually degrades to carbon dioxide and ammonia. In other environmental media, cyanide is readily degraded by microorganisms (USFWS 1975a).

Evaluation Off-Site Transport Potential. This product is contained within plastic capsules and is released into the environment when an M-44 ejector is activated. Most ejector discharges are caused by target species. The exposure pathway for ejected sodium cyanide is primarily through direct contact with and inhalation or ingestion of the toxicant. The toxicant is administered by the target individual, which places its mouth over the device and releases the ejector mechanism. This use mechanism is important in determining potential for off-site transport.

Experiments designed to study the effects of cyanide contamination of the soil from application of M-44 cyanide capsules indicate that toxic effects of cyanide would be short-lived because cyanide decomposes within 24 hours into an innocuous residue (USFWS 1975b). This is expected to greatly reduce the possibility that the cyanide could be transported off-site. Due to the application method and mode of toxicity, the only potential

exposure scenario would occur through direct contact. As M-44 devices may not be placed within 200 feet of any lake, stream, or other body of water (see use restrictions in Appendix Q), significant exposure to aquatic environment is not expected. Additionally, the amount in one capsule, 0.9 g a.i., would not provide enough active to be transported off site. Exposure in water is therefore unlikely when the formulation is used according to label specifications. Also, it is unlikely that any other exposure route would be significant for purposes of environmental exposure modeling or QRA.

(e) Toxicology

Sodium cyanide is acutely toxic to both avian and mammalian species, with LD_{50} levels generally below 10 mg/kg. Chronic toxicity to sodium cyanide poisoning is possible, but not well documented (Howard and Hanzal 1955; Hayes 1967). It is not likely that chronic toxicity will occur for the M-44 because of the limited exposure to the compound and highly toxic acute effect that occurs when the device is discharged into the mouth of an animal. Secondary toxicity is also unlikely to occur with this compound because of cyanide metabolism (Wiemeyer et al. 1986).

Metabolism. Sodium cyanide produces hydrogen cyanide gas from the moisture in the target species' mouth. The gas is a highly toxic chemical that is readily absorbed into the lungs. The cause of death is the prevention of oxygen use by tissues through the inhibition of tissue oxidative enzymes and cellular respiration (Wiemeyer et al. 1985; Manufacturing Chemists Assoc., 1967). It is estimated that M-44 cyanide ejectors produce death in the target organism in approximately two minutes after ejection of the cyanide mixture (Connolly et al. 1986; Sterner 1979). The major detoxification pathway for cyanide in many species is biotransformation to the less toxic thiocyanate compound, with up to 80 percent total cyanide excreted in the urine in the form of thiocyanate (Rutkowski et al. 1986; Wood and Cooley 1956).

Primary Toxicity. The toxicity of sodium cyanide to most animal species is very high. Both avian and mammalian species are affected at LD_{50} levels below 10 mg/kg. The registrants for M-44 capsules are requesting a waiver for inhalation toxicity tests because it is too toxic to conduct (USDA no date). Verschueren (1983) provide inhalation values of 142 ppm in air for 30 minutes (LC_{50} for rats), indicating high inhalation toxicity of the compound. Most mammals and humans were found to be acutely effected by sodium cyanide toxicity at LD_{50} levels below a 10 mg/kg dose (see Table P-11). A dose of 2.25 mg/kg in dogs was found to be lethal within 48 hours in a NIOSH document (Matheny 1978) cited in HSDB (1991e). The same NIOSH document stated that cats succumbed to a dose of 1.2 mg/kg, This is the lowest LD_{50} dose for mammals presented in Table P-11. Cattle, sheep, and rabbits have LD_{50} values below the coyote value of 4.0 mg/kg (Sterner 1979), the target species for this control method.

Avian species are similarly affected by the primary toxicity of sodium cyanide, with LD_{50} values below 10 mg/kg. Sensitive avian species include raptors, with the kestrel, vulture, and screech owl having LD_{50} values of 4.0, 4.8, and 8.6 mg/kg, respectively (Wiemeyer et al. 1986). Plant-eating birds appeared to be less sensitive, with LD_{50} values for the quail, chicken, and starling of 9.4, 21, and 17 mg/kg, respectively (Wiemeyer et al. 1986).

Chronic toxicity from sodium cyanide is not likely to occur (Manufacturing Chemists Assoc. 1967). This was confirmed by a 2-year chronic test at two times the LD_{50} value for rats (at 20 mg/kg) with no observable effects occurring (Howard and Hanzal 1955). Another study found that no lethality occurred with rats fed 250 mg/kg-d over a 90-day period (Hayes 1967). These high chronic intakes of sodium cyanide and rapid detoxification indicate low chronic toxicity.

Secondary Toxicity. Secondary toxicity is unlikely to occur from poisoning with sodium cyanide. The mode of action, chemical asphyxiation, limits the assimilation of the toxic compound into the body and tissue for availability to predators. The compound is also

rapidly metabolized to thiocyanate and excreted quickly (80 percent in urine) in animals (HSDB 19911). In general, compounds with cyanide are toxic only upon liberation of the hydrogen cyanide gas, which occurs only with primary ingestion (USFWS 1973).

(f) Screening

This compound received the highest cumulative score (73) overall. The score was based on biological considerations (score of 32) because of the presence of six potentially exposed threatened and endangered species and the highly toxic nature of the active ingredient. Environmental fate did not contribute significantly to the cumulative score.

(g) Exposure Assessment and Risk Characterization

Hazards to nontarget animals resulting from use of M-44 Cyanide Capsules may be considered significant. The M-44 is designed to specifically target only canids (i.e., coyotes, foxes, and feral dogs). However, use of M-44 Cyanide Capsules has resulted in the death of not only nontarget canids, including domestic dogs, but also other animals that are not canids, such as the badger, bobcat, skunk, porcupine, raccoon, ring-tailed cat, black bear, raven, crow, and vulture. A total of 942 nontarget deaths were reported as a result of APHIS ADC direct control in 16 States during fiscal year 1988 (see Appendix H).

Use of M-44 Cyanide Capsules also may present a hazard to threatened or endangered species. Six potentially exposed listed species occur in States where this formulated product was applied: the California condor and San Joaquin kit fox in California; the jaguarundi and ocelot in Texas and Arizona; and the gray wolf and grizzly bear in Washington, Idaho, Montana, Wyoming, and New Mexico. M-44 Cyanide Capsules apparently resulted in the death of one California condor during field use (Littrell 1990; USFWS 1992). However, Littrell (1990) states that hazards to California condors have been eliminated by hiding the ejectors under available cover to exclude them from the view of sight-feeding condors.

The label protects T&E species in stating that "the M-44 ejector device cannot be used in areas inhabited by endangered canids and felids," but the label does not specifically restrict use of the formulated product within specified ranges of the potentially exposed listed species. Therefore, M-44 Cyanide Capsules may present a hazard to listed species unless more specific modifications of its use are developed or the label is changed to designate specific restrictions within the listed species' ranges.

(2) Conclusions

Primary Toxicity. There is potential risk to nonlisted nontarget species that are likely to activate the M-44 ejector device. There is also potential risk to six listed species (California condor, San Joaquin kit fox, jaguarundi, ocelot, gray wolf, and grizzly bear) because the label for this product does not specifically restrict use within the ranges of these species.

Secondary Toxicity. No probable risk because secondary toxicity is unlikely to occur.

Aquatic. No probable risk, based on minimal off-site transport.

(3) Comparison of Findings with Those of USFWS and USEPA

USFWS and the risk assessment both concluded that the use of M-44s to control coyotes could adversely affect the California condor, the San Joaquin kit fox, the gray wolf, and the grizzly bear (USFWS 1992). USFWS states that the APHIS ADC program is not likely to jeopardize the continued existence of the kit fox, gray wolf, or grizzly bear because USEPA label use restrictions (prohibiting use of M-44s in areas where federally listed animal species may be adversely affected) adequately protect these species (USFWS 1992). USFWS does concluded that use of M-44s by the APHIS ADC program

is likely to jeopardize the continued existence of the California condor, with the primary exposure potentially occurring when a condor activates the device by its foraging activities (USFWS 1992).

No conclusions have been reached by USFWS for hazards to the ocelot and jaguarundi. The biological opinion on these two species is pending.

USEPA concluded that a may affect situation existed for the San Joaquin kit fox, jaguarundi, ocelot, and gray wolf, but that adherence to the label restrictions should eliminate hazards to all species except the San Joaquin kit fox and gray wolf (USEPA 1991b). USEPA did not address potential hazards to the California condor or the grizzly bear.

(4) Mitigation

USFWS established the following reasonable and prudent measure to minimize potential adverse effects to kit foxes: M-44 devices shall not be used to control predator species within the recognized range of the San Joaquin kit fox, per existing regulations (USFWS 1992).

USFWS established the following reasonable and prudent alternatives to avoid jeopardy to the California condor: (1) M-44s should be used in single sets (not closer than 1,000 feet from one another); and (2) the sets should be placed so that they do not protrude above ground level and should be covered or capped so they are not visible. These reasonable and prudent alternatives apply to California condor foraging habitat within Ventura, Kern, Santa Barbara, and San Luis Obispo Counties (USFWS 1992). No reasonable and prudent alternatives are established by USFWS for the gray wolf, grizzly bear, ocelot, or jaguarundi. It is recommended that use of M-44s be specifically restricted within the occupied habitat of these four listed species to reduce potential hazards.

Effective mitigation of the risk of M-44 sodium cyanide ejectors to nontarget animals requires that these animals be prevented from pulling or discharging the ejectors.

ak. Sodium Fluoroacetate — FCH_2COONa, CAS # 62-74-8 (Compound 1080, Livestock Protection Collar), 1.04 percent

(1) General Discussion

Monofluoroacetic acid (FCH_2COOH) is the shortest chained w-fluoro-fatty acid that is generally chemically stable due to the strength of the carbon-fluoride bond. The sodium salt of this compound, commonly known as Compound 1080, is currently used for coyote control only in the livestock protection collar (LPC). The LPC, attached to the neck of a sheep or goat, dispenses the toxicant when punctured by an attacking coyote. This specific end-use formulation has been used between FY 1988 and 1991 for the control of coyotes. The end-use formulation consists of a liquid contained within the livestock protection collar (LPC) placed on sheep or goats to prevent coyote depredation on commercial livestock rangeland. The concentration of active ingredient within the collar is 1.04 percent sodium fluoroacetate.

This compound was previously used as a rodenticide, but had significant nontarget effects from primary and secondary toxicity and was canceled.

(2) Use Patterns

This method was used by the APHIS ADC program in Texas between FY 1988 and FY 1991. The maximum number of collars placed on livestock annually was 906 collars; 75 were actually punctured or lost, releasing 0.05 pound of active ingredient into the environment. These collars are used mostly during the spring and summer when young animals are most likely to be attacked. When the collar is punctured, all contents are evacuated.

Some of the compound enters the coyote's mouth, some falls around the mouth, some seeps into wool or hair near the collared sheep or goat, and some eventually falls to the ground.

(3) Potentially Exposed Nontarget Species

Primary Nontarget Hazards. Primary hazards to nontarget animals could result from nontarget predator attacks on collared sheep or goats. The livestock protection collar was designed specifically to target coyotes, which attack the throat of sheep or goats (Connolly 1990). Other predators occurring in rangeland where livestock protection collars are used also may attack the throats of sheep or goats and thus be affected. Domestic dogs and bobcats have attacked collared sheep or goats and succumbed to the toxicant (punctured collars).

Primary hazards also could result from a scavenger consuming a sheep or goat carcass after Compound 1080 leaked from a punctured collar onto the carcass. Black vultures, turkey vultures, common ravens, black-billed magpies, red-tailed hawks, and skunks were observed feeding on collared goats and sheep killed by coyotes, but none were known to be poisoned by compound 1080 (Connolly 1980). Scavengers generally avoided eating wool or hair that was contaminated following breakage of the collar and fed instead on uncontaminated tissues (Connolly 1980).

Nontarget hazards to golden eagles, black-billed magpies, and skunks were tested by feeding them 1080-poisoned sheep carcasses during lab studies (Connolly 1980; Burns et al. 1984a, 1984d). Magpies and skunks showed no evidence of intoxication, but 3 of the 5 eagles exhibited sublethal symptoms that disappeared 1 to 2 days post-treatment. Lasting adverse effects were not seen.

Secondary Nontarget Hazards. Secondary toxicity theoretically could result from a scavenger consuming a 1080-poisoned coyote carcass. Potential nontarget receptors include turkey vultures and crested caracaras, which have been observed feeding on unpoisoned coyote carcasses (Connolly 1980). However, when coyotes are killed as a result of puncturing a 1080 collar, the level of contamination is so low that their tissues are not hazardous to scavengers (Connolly 1990).

Striped skunks were fed carcasses of coyotes that had been poisoned with massive overdoses of 1080 (Eastland and Beasom 1986). Four skunks died after ingesting tissues from coyotes that had received 400 mg of 1080 (the coyote LD_{50} dose is about 1 mg.). These results indicate that secondary poisoning of skunks and other animals is possible, but the likelihood is very low. To obtain such a large amount of toxicant, a coyote would have to consume the entire contents of $1\frac{1}{3}$ LPCs. However, coyotes actually ingest an average of 8.5 mg. (range 2.3 to 34.0 mg.) when they puncture LPCs (Burns et al. 1984a). Each collar contains 300 mg. a.i.

Coyotes that die after attacking and puncturing LPCs contain post-mortem 1080 residues in body tissues. Concentrations in muscle tissue average 0.24 ppm (range <0.05 to 0.93 ppm; Burns et al. 1984d). Secondary hazards posed by poisoned coyotes were studied by feeding their muscle and non-muscle soft tissue to skunks and magpies (Burns et al. 1984c). No symptoms of toxicity were detected.

Another assessment of secondary toxicity hazards was made by feeding 1080-treated diets to magpies, skunks, and eagles (Burns et al. 1984b, 1991). In 5-day feeding periods, magpies that received diets containing 0, 2.5, 5, and 10 ppm a.i. did not succumb. At 20 ppm, 2 of 6 birds died, and all birds on diets containing 40 and 80 ppm died. Adverse effects and death occurred only at 1080 concentrations much higher than are found in tissues of coyotes killed by LPCs.

Striped skunks and golden eagles were fed diets containing 4.1 and 7.7 ppm of 1080 (a.i.) respectively, for 5 days. No deaths occurred, but some eagles showed symptoms of intoxication including loss of strength and coordination, lethargy, and tremors. Both skunks and

eagles reduced their consumption of treated diets but resumed normal feeding on untreated diets and exhibited no adverse effects within a few days. Because these diets contained much higher concentrations of 1080 than are found in carcasses of coyotes killed by LPCs, and because the dietary exposure in these pen trials was much greater than would occur under field conditions, it was concluded that carcasses of coyotes killed by 1080 LPCs pose little if any hazard to these scavengers.

Domestic Animals. Domestic dogs could be susceptible to poisoning from consumption of 1080-poisoned sheep or goat carcasses. Three dogs that were allowed to scavenge on carcasses of coyotes-killed mohair goats with punctured LPCs showed no ill effects (Connolly 1980). In a laboratory study where 5 dogs fed sheep parts (head and neck with punctured collar) with 1080 contamination purposely increased to levels far greater than would occur in the field, however, 2 dogs died of 1080 poisoning. The other 3 showed no evidence of intoxication (Burns et al. 1984d). These results are consistent with other findings that primary poisoning can be caused by LPCs, but the likelihood under field conditions is low.

Domestic livestock could be affected by contamination of forage after leakage of a collar. However, this type of poisoning has not been detected during field tests and is not likely to occur (Burns et al. 1984d). Collared livestock also can be poisoned by leaking collars (Burns et al. 1984d). One possible instance of this was reported in Texas during a total of 90,000 collar use days (Walton 1992). Therefore, the risk of sheep or goats being poisoned in this manner is considered to be low.

Threatened and Endangered Species. Three listed species, the bald eagle, ocelot, and jaguarundi, could be affected by use of 1080 collars if they were to occur in rangeland where the collars are used and if they were to feed on carcasses of 1080-poisoned sheep. Use of livestock protection collars is not specifically restricted within the range of these two species. The peregrine falcon and northern aplomado falcon also occur within the range of use of 1080 collars, but these two species would not be affected because they are not likely to scavenge on carcasses of sheep, goats, or coyotes.

(a) Environmental Fate

Little environmental fate information exists for this compound. For screening purposes, a moderately high persistence was assumed.

Key Environmental Fate Properties. Sodium fluoroacetate is a chemically stable, nonvolatile compound that is relatively insoluble in most organic solvents. It is, however, both hygroscopic and extremely soluble in water. This compound might therefore be expected to leach from surface soils. Yet it also exhibits a high potential for adsorption to cellulosic matter and for absorption by plants (Schafer 1990e) and is adsorbed to clay particles (Gill no date).

In soil, sodium fluoroacetate is slowly degraded by soil microorganisms (Schafer 1990e). Most soils reportedly contain a microbial population that is sufficiently varied and abundant to result in substantial degradation of this compound (Gill no date). Accumulation in plants is limited, as most plants produce enzymes capable of degrading sodium fluoroacetate by cleaving the carbon-fluoride bond (Gill no date). In higher animals, it is metabolically converted into the highly toxic chemical fluorocitrate and has little bioaccumulation potential (Savarie 1991).

Evaluation of Off-Site Transport Potential. The active ingredient in the LPC, which is placed on the neck of the protected animal (sheep), is released upon puncture by the target individual (coyote). Although this material exhibits broad-spectrum toxicological properties, the overriding consideration concerning exposure assessment was that the LPC is the sole formulation and mode of administration being considered, and it was assumed that the a.i. would remain contained within the collar until contact was made and that it is

therefore highly unlikely to be transported off site. The residue of sodium fluoroacetate may potentially accumulate in soils if the rate of use is high; however, it is not used in ground applications and remains contained within the collar worn by sheep.

The potential exposure pathways include ingestion by the individual biting the neck of the sheep and thereby puncturing the collar, but also via two other routes of ingestion, including scavengers both of the collared sheep or goat or of the target animal killed by the collar. It is difficult to quantify nontarget off-site exposures to this product; accordingly, ingestion exposure was the sole pathway quantified.

(b) Toxicology

Mammals are extremely sensitive to Compound 1080, with acute LD_{50} levels below 1 mg/kg (USEPA 1983a). Most avian species have LD_{50} levels in the range of 1 to 20 mg/kg, showing less sensitivity but still a high degree of toxicity. Domestic animals are also sensitive and have LD_{50} values ranging from 0.06 to 1 mg/kg (Atzert 1971). Chronic cumulative toxicity has also been demonstrated on the cellular level. The chemical stability of Compound 1080 in poisoned animals indicates that secondary poisoning is likely to occur (Ward and Spencer 1947).

Metabolism. The mode of action for sodium fluoroacetate (Compound 1080) is through the inhibition of citrate metabolism, causing the internal energy supply to be reduced and ultimately causing cellular death (Atzert 1971). Sodium fluoroacetate is metabolized into fluorocitrate which is the actual toxicant. Death may then result from cardiac failure or central nervous system depression (Ward and Spencer 1947). Compound 1080 is completely absorbed in the gastrointestinal tract, with no difference in absorption between carriers (Ward and Spencer 1947; Atzert 1971). Onset of symptoms generally occurs after a delayed period, allowing for ingestion of doses greater than the amount needed to produce toxicity (USEPA 1980).

Primary Toxicity. Mammals are most sensitive to this compound, with acute LD_{50} levels below 1 mg/kg (USEPA 1980). The high toxicity to mammals was the initial reason it was used as a rodenticide until the registration was canceled. Rodents are not able to regurgitate this compound, and bait acceptance was good.

As summarized in Table P-11, the acute toxicity for birds, both seed-eating and raptors, ranges from 1.25 to 20 mg/kg for the golden eagle and turkey vulture, respectively. A five-day subchronic dietary study using the starling demonstrated that 1080 is highly toxic, with a LC_{50} concentration of 47 ppm (converted to 5.9 mg/kg-d) (Balcomb et al. 1983). This value is higher than the one-time dose LD_{50} value of 2.37 mg/kg in the starling, indicating some detoxification of the compound during the test duration (Schafer et al. 1983). The range of acute LD_{50} values for mammals is lower, with rodents ranging from 0.056 mg/kg for nutria to 12 mg/kg for white mice. The bobcat was found to have a LD_{50} value of less than 0.66 mg/kg, which is consistent with the LD_{50} level for the cat at 0.2 mg/kg (Ward and Spencer 1947). Domestic animals have LD_{50} values ranging from 0.06 to 1 mg/kg and other mammals from 0.15 to 60 mg/kg. Compound 1080 has been used previously as an insecticide, indicating high toxicity to insects (USEPA 1980; USEPA 1983a).

Chronic cumulative toxicity was demonstrated in mallards feeding on a diet of 5 mg/kg-day for 30 days, ending in mortality (USEPA 1980). Chronic adverse effects were also noted in the coyote when given 0.055 mg/kg-d for 5 days (Marsh et al 1987). These findings are consistent with the mode of action of Compound 1080 (cellular toxicity).

Secondary Toxicity. The chemical stability of compound 1080 in poisoned animals makes secondary poisoning likely (USEPA 1980; USEPA 1983a; Ward and Spencer 1947). Domestic ferrets are particularly sensitive to Compound 1080 secondary poisoning. In a study of ferrets fed mice injected with 1080, the resulting LD_{50} value was between 1 and 2 mg/kg (USEPA 1980; USEPA 1983a). Secondary toxicity, however, is not as high as acute toxicity, as demonstrated by Hegdal et al. (1980). This study indicates

that the secondary LD_{50} value for the coyote was approximately 0.4 mg/kg, while the acute LD_{50} value is 0.1 mg/kg. A study on application of 1080 rodenticide to control ground squirrels resulted in secondary hazards to birds that fed on ants killed from consuming the grain bait (Hegdal et al. 1986). This toxicity pathway is not applicable for this formulation because ants will not ingest the poison unless it is available as a food bait (Connolly, G., Personal communication, April 1992). Based on the numerous studies and reports for secondary effects of sodium fluoroacetate, secondary toxicity can be expected, but is highly unlikely with the LP Collar formulation (USEPA 1983a).

Benchmark Values. Based on the highly toxic nature of Compound 1080 to both mammals and birds, a thorough analysis was conducted in the QRA. It is noted, however, that off-site transport potential was judged to be low.

Benchmark values were determined for the three indicator species identified for each formulation below, including two raptors (black vulture and golden eagle) and one mammal (red fox). The lack of off-site transport eliminated the need for an aquatic receptor. Surrogate species were then chosen based on the available toxicology and similar physiology to the indicator. The benchmarks were derived and are listed in Table P-23. Acute toxicology studies have been performed for the two raptors. The uncertainty for these two indicator species is lower because there is no interspecies variation.

The cumulative UF for protecting the golden eagle from acute hazards was estimated to be 6 because of species variability (test was available for the golden eagle itself). This resulted in a benchmark value of 0.21 mg/kg. The chronic benchmark resulted in an additional UF of 25 to account for extrapolation from an acute to chronic endpoint and the use of a different surrogate avian species, which yielded a chronic benchmark of 0.003 mg/kg-d. The UF for protecting the black vulture from chronic exposures was calculated to be 15, yielding a benchmark of 1.0 mg/kg-d. The desert kit fox, a highly sensitive surrogate based on all other mammals listed in Table P-11, was chosen to represent acute and chronic hazards to the red fox. A cumulative UF of 6 was determined to be sufficient to protect against acute hazards, resulting in a benchmark value of 0.037 mg/kg-d. The cumulative UF value was 18, resulting in a final extrapolated benchmark value of 0.012 mg/kg for chronic exposures.

(c) Screening

This predacidal formulation received an overall score of 61. The score was based on biological considerations because of the presence of two potentially exposed threatened and endangered species and the moderately high toxicity of the active ingredient Adding to the score was the environmental fate, for which persistence and mobility scored moderately high.

(d) Exposure Assessment

Indicator Species and Exposure Factors. Three species were selected as indicators for primary and secondary toxicity of Compound 1080: the black vulture, golden eagle, and red fox. All three species are likely to occur in rangeland in Texas where LP collars are used. The black vulture was selected because 100 percent of its diet consists of carrion; therefore all of its diet could consist of pesticide-contaminated sheep. The golden eagle and red fox consume less carrion, but were selected because they are more sensitive toxicologically to sodium fluoroacetate than the black vulture.

Exposure Factors. The black vulture, golden eagle, and red fox are considered to be potentially exposed through primary ingestion of Compound 1080 on the carcass of the sheep used. The red fox was also considered for secondary exposures from eating contaminated prey, although highly unlikely. The ingestion rate of the black vulture was documented to be 140 g/d, which is calculated to be 7 percent of its body weight (4 percent according to Kenaga 1973). The golden eagle exposure was delineated above for DRC-1339 egg/meat bait exposure. The ingestion rate of the red fox was calculated to be 177

g/d, 3 percent of its body weight (Kenaga 1983). The amount of Compound 1080-contaminated carrion it eats is 10 percent. The estimated fraction of range for each nontarget was based on a 100-acre application area for the LP collar.

(e) Risk Characterization

Primary. Results for the golden eagle suggest little evidence of toxic acute exposures based on ingestion of Compound 1080 on contaminated sheep, supported by an acute HQ value of 0.23 (see Table P-27). The results indicate somewhat elevated toxicity, based on chronic exposure supported by a hazard quotient of 5.8. This elevated value was based primarily on the high order of chronic toxicity to nontarget organisms. The significant difference in the acute and chronic HQ values is explained by the greater chronic toxicity. No incidental soil ingestion pathway was calculated for primary ingestion of Compound 1080 because the formulated product was not assumed to be transported significantly from the point of application. The calculated ingestion dose was also based on most of the contents within the collar, which would then contribute minor amounts of product to the soil.

Results for Compound 1080 ingestion by the black vulture indicate no evidence of acute or chronic toxicity, supported by HQ values of 0.13 and 0.22, respectively. As mentioned in the indicator species section, the ingestion rate of carrion for the vulture is greater than that of the eagle, but it is less sensitive toxicologically, yielding a smaller HQ, most notably for chronic exposures. The analysis assumes that the entire contents of the collar is consumed each day by these scavengers.

Results addressing primary exposures to the red fox suggest potential acute and chronic hazards, based on ingesting a portion of the LP collar. The risk assessment derived HQ values of 5.7 and 17.2 for acute and chronic exposures, respectively. A major factor for the high potential hazard to the red fox is the high sensitivity of the fox to Compound 1080, with a derived acute benchmark value an order of magnitude lower than the golden eagle benchmark, a very sensitive avian species.

The potential for chronic toxicity to all three species exposed through primary ingestion is considered unlikely, based on the limited use of livestock protection collars and the low potential for repeated exposures.

Results for the quantitative risk assessment for the golden eagle and red fox indicate that acute and chronic hazards potentially exist for other scavengers feeding on sheep carcasses poisoned by Compound 1080 (see Table P-29). Three listed species (the bald eagle, ocelot, and jaguarundi) occur within the range of use of this compound and could be affected by consumption of sheep carcasses poisoned by Compound 1080. The likelihood of hazards to these three listed species is very low because the possibility of repeated ingestion of the collar toxicant is remote. Scavengers generally avoid consuming the sheep's wool, which is contaminated following breakage of the collar, and instead feed on uncontaminated tissues (Connolly 1980). Also, lab studies indicate that scavengers voluntarily reduce food intakes following the onset of effects of poisoning and thus reduce potential hazards (Burns et al. 1991).

Secondary. Results of the secondary exposure analysis for the red fox suggest that there is little potential hazard based on consuming contaminated avian species, with acute and chronic HQ values of 0.03 and 0.10, respectively. The maximum estimated tissue concentration (5 mg/kg) was based on the LD_{50} level of the golden eagle, representing the highest projected body burden among potential primary targets or nontargets of the formulated product. The golden eagle was used rather than the coyote, the only target species, because the low LD_{50} value of the coyote results in low levels of tissue contamination therefore less potential hazard to scavengers.

Aquatic. No aquatic receptors were calculated, based on the minimal off-site transport potential and use pattern detailed above.

(f) Conclusions

Primary Toxicity. No probable risk is expected for acute oral primary exposures to scavengers. Possible acute and chronic effects for the red fox if it ingests the entire contents of the collar, however, that is unlikely to occur. Potential effects are possible for chronic oral exposures to sensitive species, represented by the golden eagle, and listed species, including the bald eagle, ocelot, and jaguarundi. The likelihood of chronic exposure is very low, based on the remote possibility of repeated ingestion of the collar toxicant.

Secondary Toxicity. No probable risk is expected, based on the low HQ values for the red fox.

Aquatic. No probable risk is expected because of minimal off-site transport based on label directions.

(g) Comparison of Findings with Those of USFWS and USEPA

USFWS concluded that use of the 1080 livestock protection collar could possibly result in the mortality of bald eagles (USFWS 1985b). This conclusion is consistent with the risk assessment conclusion. USFWS further concludes that use of the collar is not likely to jeopardize the existence of the bald eagle, based on the low risk, the number of bald eagles found throughout the United States, eagle feeding patterns, and the low number of coyote carcasses and/or dead collared livestock to which the eagles are exposed (USFWS 1985b). USEPA concluded that the bald eagle would not be affected, because feeding habits reduce the possibilities of ingesting the toxicants and because the chances are remote that a listed species would come into contact with a collared sheep or goat (USEPA 1991b).

(h) Mitigation

No mitigation measures are recommended for the bald eagle because this species is unlikely to be affected by use of the collar. It is recommended, that use of the collar be specifically restricted within the recognized ranges of the ocelot and jaguarundi to protect these two species. It would be difficult to mitigate collar exposures, however, because of the unique mode of application and the difficulties associated with controlling all potential exposures.

al. Immobilizing/Euthanizing Agents

(1) General Discussion

These methods of control involve drugs to sedate or euthanize target animals. They are normally administered via direct injection. These drugs include Ketaset, Beuthanasia-D, and Rompun. They were used in three States between FY 1988 and 1991 (Nebraska, New Hampshire, Texas). Because they are administered in such a target-specific manner and involve direct disposal of euthanized animals or removal of immobilized target animals, no nontarget effects are expected. Similarly, immobilized animals are handled and transported in such a manner as to virtually eliminate the possibility of nontarget effects.

(2) Critical Element Screening

Based on the above discussion, there is very little likelihood that these compounds could contribute to nontarget effects. Accordingly, they were eliminated from further consideration, based on the risk assessment scoring criteria presented below.

(3) Documentation of Results

Primary Toxicity. No probable risk is expected, based on the critical element screening, because the formulated products are administered in a very target-specific manner.

Secondary Toxicity. No probable risk is expected because affected animals are immediately removed.

Aquatic. No probable risk is expected because of the lack of exposure pathways.

7. Discussion and Conclusions

a. Comparison of HQ values among pesticides for which QRA was conducted

The risk assessment incorporates use pattern considerations and other factors influencing potential nontarget exposures in determining the risks products could potentially have when used by the APHIS ADC program. In formulating conclusions, some of the carefully designed studies of nontarget effects (Connolly 1980; Hegdal and Gatz 1976, 1977a, 1977b; Knittle 1992; Marsh et al. 1987; Schmeltz and Whitaker 1977; Uresk et al. 1986) were reviewed to provide confirmation of risk assessment results.

(1) Selected Formulated Products Used for Risk Assessment.

The overall intent of the risk assessment was to address potential nontarget hazards associated with individual products used in the APHIS ADC program during FY 1988 through 1991 (see Table P-7). Potential nontarget hazards associated with any of the products was assessed based on the active ingredient. Assumptions were designed to be conservative such that no other formulation could generate greater nontarget hazards than the selected formulated product. Products deemed to pose potential risks, based on screening (Figures P-1, P-3) were submitted to QRA.

There were two components to the actual determination of QRA results, consisting of:

- the risk assessment calculations used to generate formulation-specific HQ values (Table P-27); and
- the ecological evaluation of potential effects to T&E species, designed to address population or community effects (Table P-29).

Overall results by formulated product have been presented above and are summarized in Table P-28. Results were generally based on both the components shown above, as are the general chemical methods conclusions.

(2) Significance of HQ and Ecological Evaluation Approach to Overall Conclusions

The QRA paradigm adopted for the present risk assessment incorporates elements of exposure and toxicity and is designed to address potential effects to individual organisms rather than to populations or ecological communities. That is to say that results expressed as Hazard Quotients (HQ) should be viewed from the perspective of whether an acute or chronic effect is likely for the individual indicator or nontarget organism of interest. There is considerable uncertainty inherent in these calculations, but this paradigm is designed to incorporate conservative assumptions that will tend to overestimate potential risks to the individual organism.

If an HQ value exceeds unity (one), the result should be interpreted as a potential risk under the stated conditions and assumptions for the individual organism. An HQ value of greater than one does not signify population or community effects, nor does it signify that every individual organism would incur the stated effect.

The ecological evaluation is not intended as a quantitative or probabilistic evaluation of the likelihood of nontarget effects to T&E species or other receptors but rather as an interpretation of whether such effects would be likely to occur.

An HQ value greater than unity does not necessarily signify that effects to the overall biological population or community would necessarily occur. If an HQ value exceeds one, the results of the ecological evaluation could still be no anticipated risk. This is because the focus of the quantitative portion of the risk assessment is toxicologically based (i.e., effects to an individual organism) rather than ecologically based (effects to a population or community).

(3) Exposure Pathways Considered

In general, the risk assessment considered four important potential exposure pathways, including primary ingestion (or absorption) of bait, secondary ingestion of prey or carcasses of animals that were poisoned through primary ingestion, incidental ingestion of soil, and contact with or exposure to contaminated surface water. The focus of these conclusions therefore relates to these pathways. Following is a brief overview of the results by pathway, presented in greater detail in the preceding section. Table P-27 summarizes HQ values for each pathway. The risk assessment conclusions by individual formulation are presented in Table P-28.

(a) Primary exposure

Risk assessment calculations indicate that acute hazards to nontarget receptors could be greatest for dermal exposure to fenthion because of its dermal toxicity and broad-spectrum toxicological properties, followed (in order of decreasing HQ values, (see Table P-27) by oral exposure to strychnine, zinc phosphide, DRC-1339, 4-aminopyridine, and Compound 1080. Chronic hazards are greatest for zinc phosphide due to high chronic toxicity and slow environmental degradation, followed by strychnine, DRC-1339, 4-aminopyridine, and Compound 1080.

(b) Secondary Exposure

Of the four formulations investigated for secondary exposure hazards, only strychnine exceeded a HQ of one, based on secondary exposure to the American kestrel (chronic HQ of 1.5), suggesting possible secondary chronic toxicity. No other active ingredients and representative indicator organisms exceeded the HQ threshold of one, including fenthion (represented by the American kestrel), strychnine S.R.O. (coyote), and DRC-1339 and 4-AP (American kestrel for both). Secondary toxicity associated with exposures to zinc phosphide were not quantitatively evaluated because of spontaneous conversion within the GI tract to phosphine gas, which is unavailable to predators and scavengers (Hill and Carpenter 1981, 1983; Matschke and LaVoie 1987; Schitoskey 1975).

(c) Incidental ingestion of soil

Calculations concerning potential incidental ingestion of soil contaminated by the active ingredient indicated that this pathway contributes only minor potential hazard as indicated by low HQ values for all receptors considered. For example, only DRC-1339 (HQ of 0.09), strychnine (0.05), and zinc phosphide (0.03) exceeded the 0.01 level. These low HQ values suggest that the soil pathway did not significantly contribute to potential hazard. Sodium fluoroacetate and fenthion were assumed not to be transported significantly off site and contribute to soil contamination, based on use patterns, and were therefore not analyzed for this pathway.

(d) Potential exposure to surface water

Exposure to surface water potentially contaminated with pesticide runoff was quantified and evaluated for the four active ingredients believed to potentially be transported off site at significant levels, which included 4-AP, DRC-1339, strychnine, and zinc phosphide. None of the HQ values for freshwater fish exceeded one either for acute or chronic exposures, which suggested a no probable risk conclusion for aquatic receptors associated with label-specified use of the formulated products.

The highest estimated HQ value was calculated for acute hazards to zinc phosphide (value of 0.4), based on a maximum possible water concentration of the active ingredient. Zinc phosphide is not expected to remain in the water column, and the chronic pathway therefore addressed water concentrations of elemental zinc, which produced a HQ value of 0.01.

b. The Role of Threatened and Endangered Species in Formulating Conclusions

Throughout this risk assessment, the potential risks to threatened and endangered species have been discussed in detail. In the discussion of specific products, for example, potential risks to threatened and endangered species within the range of application of the product are identified. Identifying such risks is an important component in ensuring that APHIS ADC practices can be carried out safely.

It is important to emphasize that the focus of the chemical risk assessment is not limited to Federal or State listed species. As noted in the Key Assumptions (see p. P-40), the approach taken in this assessment is a conservative one. Listed species are likely to be among the most sensitive populations. Identification of potential risks to listed species, therefore, is one method used to reinforce the conservative basis for the assessment of risk.

c. Comparison of Findings with USFWS Biological Opinions and USEPA Request for Section 7 Consultation

As noted above, the focus of the chemical risk assessment was on formulations used by APHIS ADC during FY 1988 through 1991. This section compares the findings of the risk assessment with conclusions from the USFWS Biological Opinions and findings from the USEPA Office of Pesticide Programs Request for Section 7 Consultation (USFWS 1979, 1982, 1989a, 1992; USEPA 1991b).

Consistency between conclusions of the risk assessment and the Biological Opinions and Request for Section 7 Consultation is generally high, but there are several important factors to consider that indicate that findings are not always consistent. They are not always directly comparable, because not all of the 18 active ingredients or all of the specific formulated products were considered. For those products that were considered, however, this comparison was conducted. The comparison is summarized in Table P-29.

It is important to emphasize that there are differences in approach and emphasis in the process used for this risk assessment and that used to produce a Biological Opinion. The focus of the chemical risk has been on retrospective and prospective evaluation of potential risk. In other words, the assessment has used data regarding actual recorded outcomes (adverse effects noted by observers, i.e., mortality), as well as outcomes produced by models. Models provide findings regarding likely outcomes, given a set of circumstances specified in the model. These circumstances include data about potential exposures, toxicity, and their potential interactions to produce risk to specified organisms. These likely outcomes are useful in identifying potentially risky situations and appropriate mitigation efforts.

In contrast, evaluations resulting in a Biological Opinion tend to be based more on information about actual recorded outcomes, and reflect a biological perspective rather than a toxicologically based risk assessment. As a result of these differences in perspective and method, the evaluations may differ.

8. Summary Recommended Mitigation Measures

Risk assessment results may identify needed mitigation measures where existing label specifications are inadequate to prevent potential nontarget effects. The purpose of this section is to make such recommendations, presented by specific pesticide formulation. The recommendations are presented in Table P-30.

A key assumption for making these recommendations is that if a product is designated no probable risk based on the risk assessment, no mitigation is required either because of inherently low nontarget hazard (i.e., risk) or because of adequate protection afforded by pesticide labels.

In some cases mitigation measures are expected to virtually preclude nontarget risks if pursued carefully, while in other instances these measures may reduce but not eliminate such exposures.

a. Mitigation Against Primary Exposure

It appears that primary exposure represents the key source of potential nontarget hazards for products potentially causing nontarget effects. For example, many of the potentially hazardous exposures identified in the risk assessment involve primary ingestion of bait, and an appropriate mitigation measure would be that prebaiting be performed, which would consist of observing the site for the presence of potentially susceptible nontarget species. Another potentially important mitigation measure is that poison baits and carcasses be removed immediately after desired control is obtained. Accordingly, while already included for many of the product labels, these simple measures could be recommended for products where this mode of exposure is potentially significant and where labels are not sufficiently protective. These include 4-aminopyridine (lacks restrictions regarding removal of carcasses); DRC-1339, 98 percent (some labels lack restrictions regarding removal of carcasses); strychnine grain baits for rodents (lacks bait removal); strychnine paste (lacks bait and carcass removal), and various zinc phosphide formulations (except muskrat control, oats, D&H, and ZP rodent bait).

The Avitrol (0.5 percent) label specifies that uneaten bait be removed from the site of application by the end of the day; it is therefore unnecessary to recommend this measure. Such a measure is also believed unnecessary for DRC-1339 (eggs and meat bait) because primary hazards are not expected to be cause for major concern to representative avian and mammalian indicators (HQ values of less than one).

Products that were subjected to QRA analysis for on-site exposures only, including sodium nitrate and aluminum phosphide, are relatively easy to mitigate, because burrows can be investigated for the presence of susceptible nontarget species and product control is less complex. Although numerous restrictions have been issued relating to application of sodium cyanide, this product is difficult to mitigate because of the unique mode of application and the difficulties associated with controlling potential nontarget exposure.

Evidence of elevated adverse effects was identified for Fenthion (Rid-A-Bird), 9 percent and 11 percent solutions (acute dermal exposure only); strychnine steam-rolled oats, 0.5 percent, strychnine milo, 0.35 percent, strychnine pastes, 1.6 and 4.9 percent (acute primary and oral exposure only); and zinc phosphide baits, 1.8 to 2.0 percent (chronic primary oral exposure only). It would be difficult to mitigate against such exposures, however, because of the unique modes of application and the difficulties associated with controlling all potential exposures.

b. Mitigation Against Secondary Exposure

Strychnine was the only compound for which secondary hazards were found to be significant. Secondary hazards for raptors associated with strychnine were identified with respect to application of all above- and belowground formulated products. To mitigate such a potential risk to raptors, it is recommended that target animal remains be removed from the area of strychnine application as soon as possible. Some of the strychnine labels specify such measures, while others do not, as stated previously.

Specific restrictions on pesticide use are recommended to protect potentially affected T&E (or other nontarget) species for each of the probable risk formulations, where such restrictions are not already included on the label. These restrictions could be included on the label or instituted through an agency-wide policy. The recommended mitigation measures for each of the potential probable risk formulations are specifically addressed by formulation. If the mitigation measures specified are carefully followed for both non-listed and listed species, the potential for risks to nontarget animals is expected to be materially reduced.

9. Overall Risk Assessment Conclusions (Chemical Methods)

In conclusion, 39 formulated products were considered in this the risk assessment. Of these, 12 were designated as *no probable risk*, based on critical element screening, numerical scoring, or the quantitative risk assessment itself. These formulated products were:

- Alpha-chloralose
- DRC-1339 (Gull Toxicant), 98 percent
- DRC-1339, 98 percent, egg and meat bait
- Mineral oil
- Glyphosate (Rodeo), 53.8 percent
- Compound PA-14 (Tergitol), 99.5 percent
- Polybutene (Eaton's 4-the-Birds)
- Brodifacoum (Weather Blok), 0.005 percent
- Cholecalciferol (Quintox), 0.075 percent
- Zinc phosphide, 63 percent concentrate for rat control
- Bone tar oil (Magic Circle Deer Repellent), 93.75 percent
- Immobilizing/euthanizing agents.

This conclusion suggests if label specifications are followed and use patterns continued as in the past, no adverse effects are expected for any of these products.

The remaining 27 formulated products were designated as having *potential for risk* based on the quantitative risk assessment. These 27 formulated products were:

- 4-aminopyridine (Avitrol), 0.5 percent
- 4-aminopyridine (Avitrol), 25 percent
- DRC-1339, 98 percent, feedlots
- DRC-1339, 98 percent, structures

- DRC-1339, 98 percent, staging areas
- DRC-1339 (Starlicide Complete), 0.1 percent
- Fenthion (Rid-A-Bird), 11 percent
- Fenthion (BCF#1), 9 percent
- Strychnine, pigeon corn bait
- Strychnine, bird toxicant
- Strychnine, sparrow-cracks
- Aluminum phosphide, 55 percent or 57 percent
- Sodium nitrate (gas cartridge for rodents), 43.36 percent
- Strychnine, SRO, 0.5 percent
- Strychnine, milo, 0.35 percent
- Strychnine, 1.6 percent, paste
- Strychnine, 4.9 percent, paste
- Strychnine, 5.79 percent, salt block
- Zinc phosphide concentrate for mouse control, 63 percent
- Zinc phosphide concentrate for muskrat and nutria control, 63 percent
- Zinc phosphide on steam-rolled oats, 2 percent
- Zinc phosphide (Rodent Bait AG), 2 percent
- Zinc phosphide (D&H Formula Rodent Rid-R), 2 percent
- Zinc phosphide on wheat, 1.82 percent
- Sodium cyanide (M-44 Cyanide Capsules), 88.62 percent
- Sodium fluoroacetate (Compound 1080)
- Sodium nitrate (gas cartridges for coyotes).

Of these 27 formulated products, only the 8 strychnine formulations were designated as potential risk based on secondary exposure. No compounds were designated as potential risk compounds based on either soil or surface water exposure.

If the recommended mitigation measures specified for the key products found to have a potential for risk are followed and use patterns are continued as in the past, no adverse effects are expected for any of the above formulated products.

Table P-28

Risk Assessment Conclusions by Individual Formulation

Formulated Product	*Quantitative Risk Assessment Designation* [a] *Primary Pathway* acute desig./HQ/species	*Primary Pathway* chronic desig./HQ/species	*Secondary Pathway* acute desig./HQ/species	*Secondary Pathway* chronic desig./HQ/species
Alpha-chloralose	no probable risk [b]	no probable risk [b]	no probable risk [b]	no probable risk [b]
4-Aminopyridine (representative scenario is 0.5% formulation)				
0.5% formulation	probable risk/2 Eastern meadowlark	probable risk/274 Eastern meadowlark	no probable risk/0.01 American kestrel	no probable risk/<0.01 American kestrel
25% concentrate	probable risk/1,509 American crow	no probable risk [a]	no probable risk [d]	no probable risk [d]
DRC-1339 (98%) (representative scenario is staging area)				
Feedlots, and Starlicides Complete, 1%	probable risk/234 Eastern meadowlark	probable risk/221 Eastern meadowlark	[d]	[d]
Structures	probable risk/1,734 house finch	probable risk/1,635 house finch	[d]	[d]
Staging area	probable risk/1,758 Northern cardinal	probable risk/1,658 Northern cardinal	no probable risk/<0.01 American kestrel	no probable risk/0.02 American kestrel
Gull toxicant	no probable risk [b]	no probable risk [b]	no probable risk [b]	no probable risk [b]
Egg and meat baits	no probable risk/0.16 golden eagle	no probable risk/0.8 golden eagle	[d]	[d]
Egg and meat baits	no probable risk/0.16 coyote	no probable risk/0.4 coyote	[d]	[d]
Fenthion (representative scenario is Rid A Bird 11%)				
(Rid A Bird 11%, BCF#1, 9%)	probable risk/1.E+5 house finch	[e]	no probable risk/0.1 American kestrel	no probable risk/0.3 American kestrel
Mineral Oil	no probable risk [c]	no probable risk [c]	no probable risk [c]	no probable risk [c]
Glyphosate (Rodeo), 53.8%	no probable risk [b]	no probable risk [b]	no probable risk [b]	no probable risk [b]
Compound PA-14 (Tergitol), 99.5	no probable risk [b]	no probable risk [b]	no probable risk [b]	no probable risk [b]
Polybutene (Eatons 4 the Birds)	no probable risk [c]	no probable risk [c]	no probable risk [c]	no probable risk [c]

(Continued)

Table P-28 (Continued)

Risk Assessment Conclusions by Individual Formulation

Formulated Product	Quantitative Risk Assessment Designation [a]			
	Primary Pathway		Secondary Pathway	
	acute desig./HQ/species	chronic desig./HQ/species	acute desig./HQ/species	chronic desig./HQ/species
Strychnine (representative scenario is SRO 0.5% above ground)				
Pigeon bait, bird toxicant, sparrow-cracks	probable risk/3,230 Eastern meadowlark	probable risk/384 Eastern meadowlark	no probable risk/0.6 American kestrel	probable risk/1.5 American kestrel
SRO 0.5%, above ground	probable risk/4,037 horned lark	probable risk/480 horned lark	no probable risk/0.4 American kestrel	probable risk/1.0 American kestrel
	probable risk/10,338 deer mouse	probable risk/1,632 deer mouse	no probable risk/0.4 coyote	no probable risk/<0.01 coyote
0.35% milo	probable risk/2,826 horned lark	probable risk/336 horned lark	no probable risk [g] American kestrel	no probable risk[g] American kestrel
	probable risk/7,237 deer mouse	probable risk/1,142 deer mouse	no probable risk [g] coyote	no probable risk [g] coyote
1.6% paste	probable risk/17,161 deer mouse	probable risk/2,709 deer mouse	[g]	[g]
4.9 paste	probable risk/5,582 deer mouse	probable risk/881 deer mouse	[g]	[g]
5.79% salt block	probable risk [g]	probable risk [g]	[g]	[g]
Aluminum Phosphide, 55% or 57%	probable risk[h]	no probable risk[h]	[i]	[i]
Brodifacoum (Weather Blok), 0.005%	no probable risk[c]	no probable risk[c]	no probable risk[c]	no probable risk[c]
Cholecalciferol (Quintox), 0.075%	no probable risk[b]	no probable risk[b]	no probable risk[b]	no probable risk[b]
Sodium Nitrate (Gas Cartridge for Rodents), 43.36%	probable risk[h]	no probable risk[h]	[i]	[i]
Zinc Phosphide (representative scenario is 2% AG, with muskrat concentrate for aquatic receptors)				
Concentrate for mouse control	probable risk/1,202 deer mouse	probable risk/551 deer mouse	[i]	[i]
Concentrate for muskrat control	[g]	[g]	[i]	[i]
Concentrate for rat control	no probable risk [b]	no probable risk [b]	no probable risk [b]	no probable risk [b]

(Continued)

Table P-28 (Continued)

Risk Assessment Conclusions by Individual Formulation

	Quantitative Risk Assessment Designation [a]			
	Primary Pathway		*Secondary Pathway*	
Formulated Product	**acute desig./HQ/species**	**chronic desig./HQ/species**	**acute desig./HQ/species**	**chronic desig./HQ/species**
2% AG formulation (includes D&H and ZP Rodent Bait)	probable risk/341 ring-necked pheasant	probable risk/10,556 ring-necked pheasant	i	i
	probable risk/3,643 deer mouse	probable risk/1,671 deer mouse	i	i
SRO and Wheat 2-1.8%[g]		g	i	i
Bone Tar Oil (Magic Circle Deer Repellent), 93.75%	no probable risk [c]	no probable risk [c]	no probable risk [c]	no probable risk [c]
Sodium Cyanide (M-44 Cyanide Capsules), 88.62%	probable risk[h]	no probable risk[h]	i	i
Sodium Fluoroacetate (Compound 1080) LP collar	no probable risk/0.2 golden eagle	probable risk/5.8 golden eagle	no probable risk/0.03 red fox	no probable risk/0.10 red fox
	probable risk/5.7 red fox	probable risk/17.2 red fox	d	d
	no probable risk/0.1 black vulture	no probable risk/0.2 black vulture	d	d
Sodium Nitrate (Gas Cartridge for Coyotes)	probable risk[h]	no probable risk[h]	i	i
Immobilizing/ Euthanizing Agents	no probable risk [c]	no probable risk [c]	no probable risk [c]	no probable risk [c]

[a] Information taken from Table P-27.
[b] Formulation screened out based on score below the threshold value of 35 (see Tables P-12, P-14).
[c] Formulation eliminated from a more detailed analysis, based on critical element screening (see Tables P-12, P-13).
[d] Believed no probale risk based on findings from representative scenario calculations.
[e] Chronic exposure for primary pathway not calculated because of the extreme acute toxicity.
[f] No aquatic receptors were determined, based on minimal off-site transport.
[g] Scoring for this formulation (Table P-14) indicates probable designation, based on similarity to representative formulation.
[h] Benchmark and HQ values were not dirived based on minimal off-site transport evaluation.
[i] No secondary hazards were addressed because secondary toxicity is not expected.

Table P-29

Conclusions for Threatened and Endangered Species From the Risk Assessment and USFWS Biological Opinions, by Formulation

Pesticide	Potentially Affected Species	Status [a]	Hazard Type [b]	Risk Assessment	U.S. Fish & Wildlife Service Biological Opinions
Avicides					
4-Aminopyridine (Avitrol), 0.5%					
	whooping crane	E	1	probable risk	may affect, no jeopardy (USFWS 1992)
	Attwater's greater prairie chicken	E	1	probable risk	may affect, no jeopardy (USFWS 1979)
	Aleutian Canada goose	T	1	probable risk	may affect, no jeopardy (USFWS 1979)
	northern aplomado falcon	E	2	no probable risk (HQ values)	
	bald eagle	T&E	2	no probable risk (HQ values)	
	peregrine falcon	E	2	no probable risk (HQ values)	
DRC-1339, 98%, feedlots; Starlicide Complete, 0.1%					
	Aleutian Canada goose	T	1	no probable risk (habitat)	may affect, no jeopardy (USFWS 1979)
	whooping crane	E	1	no probable risk (habitat)	may affect, no jeopardy (USFWS 1992)
	bald eagle	T&E	2	no probable risk (HQ values)	
	peregrine falcon	E	2	no probable risk (HQ values)	
DRC-1339, 98%, structures					
	bald eagle	T&E	2	no probable risk (HQ values)	
	peregrine falcon	E	2	no probable risk (HQ values)	
DRC-1339, 98%, staging areas					
	Attwater's greater prairie chicken	E	1	probable risk	
	whooping crane	E	1	probable risk	
	northern aplomado falcon	E	2	no probable risk (HQ values)	
	bald eagle	T&E	2	no probable risk (HQ values)	
	peregrine falcon	E	2	no probable risk (HQ values)	

(Continued)

Table P-29 (Continued)

Conclusions for Threatened and Endangered Species From the Risk Assessment and USFWS Biological Opinions, by Formulation

Pesticide	Potentially Affected Species	Status [a]	Hazard Type [b]	Risk Assessment	U.S. Fish & Wildlife Service Biological Opinions
DRC-1339, 98%, eggs/meat bait					
	California condor	E	1	no probable risk (HQ values)	
	bald eagle	T&E	1	no probable risk (HQ values)	
	San Joaquin kit fox	E	1	no probable risk (HQ values)	
	grizzly bear	T	1	no probable risk (HQ values)	
	gray wolf	E	1	no probable risk (HQ values)	
	jaguarundi	E	1	no probable risk (HQ values)	
	ocelot	E	1	no probable risk (HQ values)	
Fenthion (BCF#1, 9%, and Rid-A-Bird, 11%)					
	bald eagle	E	2	no probable risk (HQ values)	
	peregrine falcon	E	2	no probable risk (HQ values)	
Strychnine (Avicides)					
	Attwater's greater prairie chicken	E	1	no probable risk (habitat)	
	whooping crane	E	1	no probable risk (habitat)	
	northern aplomado falcon	E	2	probable risk (chronic tox only)	
	bald eagle	T&E	2	probable risk (chronic tox only)	
	peregrine falcon	E	2	probable risk (chronic tox only)	may affect, no jeopardy (USFWS 1992)
	jaguarundi	E	2	no probable risk (habitat)	
	ocelot	E	2	no probable risk (habitat)	
	Louisiana black bear	T	2	no probable risk (habitat)	

(Continued)

Table P-29 (Continued)

Conclusions for Threatened and Endangered Species From the Risk Assessment and USFWS Biological Opinions, by Formulation

Pesticide	Potentially Affected Species	Status [a]	Hazard Type [b]	Risk Assessment	U.S. Fish & Wildlife Service Biological Opinions
Rodenticides					
Aluminum phosphide					
	New Mexican ridge-nosed rattlesnake	T	1	probable risk	may affect, jeopardy (USFWS 1989)
	Mexican gray wolf	E	1	no probable risk (habitat)	
Sodium nitrate gas cartridge for rodents					
	Fresno kangaroo rat	E	1	probable risk	may affect, no jeopardy (USFWS 1992)
	giant kangaroo rat	E	1	probable risk	may affect, no jeopardy (USFWS 1992)
	Morro Bay kangaroo rat	E	1	probable risk	may affect, no jeopardy (USFWS 1992)
	Stephens' kangaroo rat	E	1	probable risk	
	Tipton kangaroo rat	E	1	probable risk	may affect, no jeopardy (USFWS 1992)
	salt marsh harvest mouse	E	1	probable risk	may affect, no jeopardy (USFWS 1992)
	Point Arena mountain beaver	E	1	probable risk	
	black-footed ferret	E	1	no probable risk (label mitigation)	
	San Joaquin kit fox	E	1	no probable risk (label mitigation)	
	gray wolf	T	1	no probable risk (habitat)	
	New Mexican ridge-nosed rattlesnake	T	1	probable risk	may affect, jeopardy (USFWS 1989)
	San Francisco garter snake	E	1	probable risk	may affect, no jeopardy (USFWS 1992)
	blunt-nosed leopard lizard	E	1	no probable risk (label mitigation)	
	island night lizard	T	1	probable risk	
	gopher tortoise	T	1	no probable risk (label mitigation)	

(Continued)

Table P-29 (Continued)

Conclusions for Threatened and Endangered Species From the Risk Assessment and USFWS Biological Opinions, by Formulation

Pesticide	Potentially Affected Species	Status [a]	Hazard Type [b]	Risk Assessment	U.S. Fish & Wildlife Service Biological Opinions
	desert tortoise	T	1	probable risk	may affect, no jeopardy (USFWS 1992)
	Santa Cruz long-toed salamander	E	1	probable risk	
Strychnine grain, above-ground use					
	Aleutian Canada goose	T	1	no probable risk (label mitigation)	may affect, no jeopardy (USFWS 1992)
	whooping crane	E	1	probable risk	may affect, no jeopardy (USFWS 1992)
	gray wolf	E	2	no probable risk (label mitigation)	
	bald eagle	E	2	probable risk (chronic tox)	may affect, jeopardy to Southwest population only (USFWS 1992)
	peregrine falcon	E	2	probable risk (chronic tox)	
Strychnine grain, below-ground use					
	ocelot	E	2	no probable risk (HQ values)	
	jaguarundi	E	2	no probable risk (HQ values)	
	gray wolf	E	2	no probable risk (label mitigation)	
	northern aplomado falcon	E	2	probable risk (chronic tox)	
	bald eagle	T&E	2	probable risk (chronic tox)	
	peregrine falcon	E	2	probable risk (chronic tox)	
Strychnine paste					
	whooping crane	E	1	probable risk	
	woodland caribou	E	1	no probable risk (habitat)	
	bald eagle	T&E	2	probable risk (chronic tox)	may affect, no jeopardy (USFWS 1982)

(Continued)

Table P-29 (Continued)

Conclusions for Threatened and Endangered Species From the Risk Assessment and USFWS Biological Opinions, by Formulation

Pesticide	Potentially Affected Species	Status [a]	Hazard Type [b]	Risk Assessment	U.S. Fish & Wildlife Service Biological Opinions
	peregrine falcon	E	2	probable risk (chronic tox)	may affect, no jeopardy (USFWS 1982)
	gray wolf	E	2	no probable risk (label mitigation)	
	grizzly bear	T	2	no probable risk (label mitigation)	
Strychnine salt block [c]					
	bald eagle	T	2	probable risk	
	peregrine falcon	E	2	probable risk	
	northern spotted owl	T	2	probable risk	
Zinc phosphide concentrate for mouse control					
	whooping crane	E	1	probable risk	
	woodland caribou	E	1	no probable risk (habitat)	
Zinc phosphide grain bait					
	whooping crane	E	1	no probable risk (label mitigation)	may affect, no jeopardy (USFWS 1992)
	Aleutian Canada goose	T	1	probable risk	may affect, no jeopardy (USFWS 1992)
Predacides					
Sodium Cyanide M-44 capsules					
	California condor	E	1	probable risk	may affect, jeopardy (USFWS 1992)
	San Joaquin kit fox	E	1	probable risk	may affect, no jeopardy (USFWS 1992)
	jaguarundi	E	1	probable risk	
	ocelot	E	1	probable risk	
	gray wolf	E	1	probable risk	may affect, no jeopardy (USFWS 1992)
	grizzly bear	T	1	probable risk	may affect, no jeopardy (USFWS 1992)

(Continued)

Table P-29 (Continued)

Conclusions for Threatened and Endangered Species From the Risk Assessment and USFWS Biological Opinions, by Formulation

Pesticide	Potentially Affected Species	Status [a]	Hazard Type [b]	Risk Assessment	U.S. Fish & Wildlife Service Biological Opinions
Sodium Fluoroacetate (Compound 1080), livestock protection collar					
	ocelot	E	1	probable risk	
	jaguarundi	E	1	probable risk	
	bald eagle	E	1	probable risk	may affect, no jeopardy (USFWS 1985b)
Sodium Nitrate gas cartridge for coyotes					
	San Joaquin kit fox	E	1	no probable risk (label mitigation)	
	Utah prairie dog	T	1	no probable risk (habitat)	
	gray wolf	E	1	no probable risk (label mitigation)	
	black-footed ferret	E	1	no probable risk (habitat)	
	New Mexican ridge-nosed rattlesnake	T	1	no probable risk (habitat)	
	blunt-nosed leopard lizard	E	1	no probable risk (habitat)	may affect, no jeopardy (1992)
	desert tortoise	T	1	no probable risk (habitat)	
	San Francisco garter snake	E	1	no probable risk (habitat)	
	Wyoming toad	E	1	no probable risk (habitat)	

[a] Status: T = Threatened, E = Endangered, T&E = Threatened in some areas, endangered in other areas (bald eagle).
[b] The numbers represent the type of hazard, either primary (1) or secondary (2) for the listed species.
[c] This product has not been used since 1989, when APHIS ADC voluntarily cancelled it's registration.

Table P-30

Potential Exposures and Mitigations for Chemical Methods

Active ingredient/ Product name	Potential Exposure Pathways	Product Label Restrictions	Conclusion/Recommended Additional Mitigation [a]
Avicides and Other Agents			
Alpha-chloralose	Primary ingestion	Do not use during or prior to hunting season; hand feed target, pick up baits and immobillized targets within a few hours	No effect/no further mitigation needed
4-Aminopyridine/Avitrol 0.5 percent	Primary & secondary ingestion; off-site transport	Prebait; pick up bait and carcasses after control is obtained	May affect/restrict use for ACG in CA
4-Aminopyridine/Avitrol 25 percent	Primary & secondary ingestion	Prebait, retrieve bait after control is obtained, do not use if non-targets present	May affect/additional mitigation infeasible
DRC-1339 for Feedlots	Primary & secondary ingestion; off-site transport	Prebait; pick up bait and carcasses; restrict use if endangered species present	May affect/restrict in range of WCA and ACG
DRC-1339 Gull Toxicant	Primary ingestion	Hand feed; restrict access to waterfowl or other non-targets; seasonal restrictions	No effect/no further mitigation needed
DRC-1339 (egg & meat bait)	Primary ingestion; off-site transport	Restrict use if non-targets present; meat baits must be observed throughout in AZ, NM; remove bait	May affect/no additional mitigation needed
DRC-1339 for Structures	Primary & secondary ingestion; off-site transport	Prebait, pick up bait and carcasses	May affect/no further mitigation recommended
DRC-1339 for Staging Areas	Primary & secondary ingestion; off-site transport	Prebait, pick up bait	May affect/restrict within range of WCA and APC
DRC-1339/Starlicide Complete	Primary & secondary ingestion; off-site transport	Prebaiting for non-targets, must not endanger protected birds and domestic fowl	May affect/no further mitigation recommended
Fenthion/Rid-A-Bird; BCF#1	Dermal, primary & secondary ingestion	Survey for presence of non-targets or raptors (use other method if present); remove carcasses	May affect/additional mitigation infeasible (no T&E species concerns)
Mineral Oil	Asphyxiation	Apply directly to target eggs	No effect/none required
Glyphosate (Rodeo), 53.8 percent	Habitat defoliation	No non-target restrictions	No effect/none required
Compound PA-14 (Tergitol), 99.5 percent	Hypothermia	Restrict application to immediate target roost area	No effect/no T&Es co-occur with blackbirds in roosts
Polybutene (Eatons 4 the Birds), 80 percent	Odor repellent	No restrictions required	No effect/none required
Strychnine Corn Pigeon Bait	Primary & secondary ingestion	Requires 5 mile buffers near PF nests; observe for presence of non-targets on daily basis; pick up bait and carcasses	May affect/restrict within range of NAF

(Continued)

Table P-30 (Continued)

Potential Exposures and Mitigations for Chemical Methods

Active ingredient/ Product name	Potential Exposure Pathways	Product Label Restrictions	Conclusion/Recommended Additional Mitigation [a]
Strychnine Sparrow-cracks	Primary & secondary ingestion	Prebait; pick up bait and carcasses	May affect/restrict within range of NAF
Strychnine Bird Toxicant	Primary & secondary ingestion	Prebait; pick up bait and carcasses	May affect/restrict within range of NAF
Rodenticides			
Aluminum Phosphide/Fumitoxin; Phostoxin; Delta-Rotox	Inhalation	Inspect dens for presence of non-targets; various T&E restrictions	May affect/prohibit use above 6,000 feet
Brodifacoum (Weather Blok), 0.005 percent	Primary ingestion	Place in tamper-proof boxes away from children, animals or wildlife	No effect (no non-targets present)/no mitigation required
Cholecalciferol (Quintox), 0.075 percent	Primary ingestion	Place in tamper-proof boxes away from children, animals or wildlife	No effect (no T&E species present)/no mitigation required
Sodium Nitrate/Rodent Gas Cartridge	Inhalation	Various T&E restrictions for BFF, UPD, SJKF, BNLL, EIS, DT	May affect/prohibit use above 6,000 ft. and in salt marshes in San Mateo and Mendocino Co., CA
Strychnine/Above Ground (0.35 percent & 0.5 percent)	Primary & secondary ingestion; off-site transport	APHIS ADC use restriction near WCA; pick up carcasses; restrict use near BFF, CC, SJKF, ACG, KR, GW, GB, SMHM	May affect/prohibit use within 5 miles of bald eagle roosts
Strychnine/Below Ground (0.35 percent & 0.5 percent)	Primary ingestion; off-site transport	Do not apply on surface	May affect/pick up carcasses to protect PF, NAF, and BE; use zinc phosphide whenever possible
Strychnine Rabbit Paste (1.6 percent)	Primary & secondary ingestion; off-site transport	Pick up bait and carcasses; restrict use in range of CC, SJKF, ACG, MBKR, GW, GB, SMHM	May affect/restrict use within migratory range of WCA; pick up carcasses, restrict use of bait where eagles are known to occur
Strychnine Marmot Paste (4.9 percent)	Primary & secondary ingestion; off-site transport	Pick up bait and carcasses; restricts use in range of CC, SJKF, ACG, KR, GW, GB, SMHM	May affect/restrict use within migratory range of WCA; pick up carcasses, restrict use of bait where eagles are known to occur
Strychnine Salt Block (porcupine)	Primary & secondary ingestion; off-site transport	Restricts use in range of CC, SJKF, ACG, KR, GW, GB, SMHM	May affect/restrict use within documented range of PF, BE and NSO; pick up carcasses, restrict use of bait where eagles are known to occur

(Continued)

Table P-30 (Continued)

Potential Exposures and Mitigations for Chemical Methods

Active Ingredient/ Product name	Potential Exposure Pathways	Product Label Restrictions	Conclusion/Recommended Additional Mitigation [a]
Zinc Phosphide Concentrate - Mouse (-6)	Primary ingestion; offsite transport	Restrictions on various endangeredspecies, WCA, APC, YSB, SMHM, KR, ACG; do not apply over bodies of water	May affect/restrict within migratory range of WCA
Zinc Phosphide Concentrate - Muskrat (-9)	Primary ingestion; offsite transport	Restrictions on various T&E species; prebait; remove bait and carcasses after 72 hours	May affect/ no additional mitigation included (no T&E concerns)
Zinc Phosphide Concentrate - Rat (-7)	Primary ingestion	Remove bait and carcasses; place in tamper proof boxes or inaccessible locations; various T&E restrictions	No effect/ no additional mitigation needed
Zinc Phosphide Oats (2 percent)	Primary ingestion; offsite transport	Restricted use within range of WCA, UPD, BFF and others; prebait and remove unused bait	May affect/prohibit use in select CA and OR counties for ACG.
ZP Rodent Bait AG; D&H Formula Rid-R; ZP rodent pellets (2 percent)	Primary ingestion; offsite transport	Restricted use within range of various T&E species (contact counties for specific locations); remove bait and carcasses (one label)	May affect/prohibit use in select CA and OR counties for ACG.
Zinc Phosphide on Wheat (1.82 percent)	Primary ingestion; offsite transport	Restricted use within range of WCA; and other T&E species	May affect/prohibit use in several CA and OR counties for ACG.
Predacides & Other Agents			
Bone Tar Oil (Magic Circle Deer Repellent), 93.75 percent	Odor repellent	Keep away from children	No effect/no mitigation required
Sodium Cyanide/M-44 Cyanide Capsules	Inhalation/ingestion	Many restrictions, including limiting T&E exposure	May affect/restrict use within recognized range of SWKF, GW, GB, OCE, JAG
Sodium Fluoroacetate/ Compound 1080	Primary & secondary ingestion	Dispose of used collar and carcasses; beware of T&Es (not listed); restricted use in wildlife refuges and parks	May affect/restrict within range of OCE and JAG
Sodium Nitrate/Coyote Gas Cartridge	Inhalation	Burrows investigated for presence of non-targets	No effect/no additional mitigation required
Tranquilizers/Euthanizing Agents	Primary injection	None	No effect/no mitigation required

[a] Species codes are as follows: ACG = Aleutian Canada goose, APC = Attwater's greater prairie chicken; BE = bald eagle; CC = California condor; DETO = desert tortoise; GB = grizzly bear; GW = gray wolf; INL = island night lizard; JAG = jaguarundi; KR's = kangaroo rats (Fresno, giant, Morro Bay, Stephens' and Tipton); NAF = northern aplomado falcon; NMRR = New Mexican ridge-nosed rattlesnake; NSO = northern spotted owl; OCE = ocelot; PAMB = Point Arena mountain beaver; PF = peregrine falcon; SCLS = Santa Cruz long-toed salamander; SFGS = San Francisco garter snake; SJKF = San Joaquin kit fox; SMHM = salt marsh harvest mouse; WCA = woodland caribou; WCR = whooping crane; YSB = yellow-shouldered blackbird.

RISK ASSESSMENT GLOSSARY

A

ABIOTIC	Related to the inanimate or physical environment; see BIOTIC.
ABUNDANCE	The number of individuals in a population of a species in a given unit of area.
ACTIVE INGREDIENT (a.i.)	The chemical or chemicals in a pesticide formulation responsible for the desired effects.
ACUTE- CHRONIC RATIO	A compound-specific ratio of short- and long-term toxicity benchmarks, calculated by dividing the most appropriate short-term (acute) value by the most appropriate long-term (chronic) value.
ACUTE TOXICITY	Death or physiological disorder in an organism resulting from a single dose of, or exposure to a compound or compound mixture. All acute exposures occur over a small portion of the organism's lifespan or life cycle; see CHRONIC TOXICITY, SUB-CHRONIC TOXICITY. Most acute testing is conducted over a short exposure period (e.g.,96 hours).
ADSORPTION	The affinity of a chemical substance for particulate surfaces. Adsorption is an important factor affecting environmental movement and fate of chemicals; see DESORPTION, SORPTION.
ADVERSE IMPACT/EFFECT	A condition caused by a specific action that results in harm to an organism or its habitat.
ALD	Assumed lethal dose based on limited mortality information, similar to LD_{50} but with greater uncertainty.
ANTICOAGULANTS	Chemicals, particularly rodenticides, that cause death by interfering with animals' blood clotting mechanisms.
APPLICATION RATE	The amount of pesticide product applied per unit area.
AQUATIC LIFE	Organisms inhabiting water for all or part of their lifecycle.
AVICIDE	A pesticide used to control or reduce damage caused by birds.

B

BAIT	A lure or attractant consisting of a target animal's preferred food, fetid meat, urine, or musk.
BENCHMARK	see Toxicological Benchmark.
BIO - ACCUMULATION	The process whereby exposure of an animal to a chemical or its residues through dermal, respiratory, and ingestion routes result in higher levels of that chemical or its residues in tissues than occur in the surrounding environment. This term is used primarily for terrestrial species; see BIOCONCENTRATION.

P Appendix

BIOASSAY	A test using organisms to determine the toxicity of a compound or chemical mixture. Its primary function is to provide case-specific information regarding the toxicity of a compound or chemical mixture.
BIOCIDE	A chemical substance that kills any form of life (i.e., generalized term for pesticide).
BIOCONCENTRATION	The property of some chemicals to collect in tissues of certain species at concentrations higher than the surrounding environment. This may occur through uptake of contaminated water, dermal penetration from skin exposure, respiratory intake, or consumption of contaminated components of the environment. This term is used primarily for aquatic species; see BIOACCUMULATION.
BIOCONCENTRATION FACTOR (BCF)	The ratio of concentration of a chemical within the tissue of an organism, to that in the surrounding medium (frequently water).
BIODEGRADATION	The process of decomposition of a substance aided by the action of microorganisms (e.g., bacteria, molds, fungi).
BIOLOGICAL IMPACT	Any impact to animal abundance or species diversity.
BIOLOGICAL OPINION	The written result of a Section 7 Consultation, as required by the Endangered Species Act (ESA), conducted by Federal agencies with the U.S. Fish and Wildlife Service (USFWS). The opinion of the USFWS as to whether or not the Federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat (see Section 7 Consultation).
BIOMAGNIFICATION	The process by which a chemical concentrates as it moves through the food chain; see BIOACCUMULATION, BIOCONCENTRATION.
BIOTIC	Relating to living organisms.

C

CHEMICAL CONTROL METHODS	Toxicants (including fumigants and anticoagulants), repellents, frightening or stressing agents, and drugs used to control wildlife damage.
COMMENSAL RODENT	A rodent that lives in close proximity to humans (e.g., Norway rat, roof rat, house mouse).
CHRONIC TOXICITY	An adverse biologic response, such as mortality or an effect on growth or reproductive success, resulting from repeated or long term (3 months) (exposures) to a compound (usually at low concentrations); see ACUTE TOXICITY, SUBCHRONIC TOXICITY.
CONCENTRATION	An amount of a substance in a specified amount of medium (air, water, etc.). Measured in parts-per-million (ppm), milligrams-per-cubic-meter (mg/m3), or other appropriate units; see DOSE.
CRITICAL ELEMENT	Specified pesticide characteristics which would be cause for immediate elimination from further consideration in the QRA; including use pattern characteristics, presence of potential non-target receptors, exposure pathways and toxicological properties.
CRITICAL HABITAT	The essential segment(s) of habitat that contains the unique combination of conditions (i.e., vegetation, topography, soils, species niches, etc.) necessary for the continued survival of an endangered or threatened species, as listed in 50 CFR 17 or 226.
CUMULATIVE	Increased concentration in the body through repeated exposure to a chemical.
CUMULATIVE IMPACTS	The impacts on the environment resulting from the incremental impact added to past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions occurring over time.

D

DEGRADATION	Transformation of a compound by physiochemical or biochemical processes into its basic components.
DESORPTION	Loss of a chemical from a surface to which the chemical had adhered; see ADSORPTION, SORPTION.
DIRECT CONTROL	The conduct or supervision of wildlife damage control activities (see Technical Assistance).
DIVERSITY	The number of species in a specific area.
DOSE	An amount of substance administered per unit of animal body weight. Measured in milligrams of substance per kilogram of animal body weight (mg/kg), or other appropriate units; see CONCENTRATION
DRIFT	The airborne movement of a pesticide (e.g., sprayed insecticide) away from the targeted site of an application.
DURATION	A criterion used in this EIS to evaluate the significance of ADC program impacts on target species abundance. Duration refers to the length of time the control activity has been or could be in operation.

E

EC_{50}	MEDIAN EFFECTIVE CONCENTRATION; concentration eliciting a non-lethal response in 50 percent of the organisms tested; see LC_{50}.
ECOLOGICAL COMMUNITY	Any assemblage of populations living in a specific habitat.
ECOLOGICAL HAZARD	Actual or potential adverse effects of wildlife damage management actions on plants and/or animals other than humans.
ECOLOGICAL RISK ASSESSMENT	An appraisal of the actual or potential effects of wildlife damage management actions on plants and/or animals other than humans.
ED_{50}	MEDIAN EFFECTIVE DOSE; dose eliciting a non-lethal response in 50 percent of the organisms tested; see LD_{50}.
EFFICACY	The ability to produce a desired effect or intended result; the effectiveness of a wildlife damage control tool or action.
EMULSIFIABLE CONCENTRATE	A formulation in concentrated form to be mixed into a suspension (i.e., emulsion).
ENDANGERED SPECIES	A species in danger of extinction throughout all or a significant part of its range.
ENDPOINT	A toxicological response or measured effect.
END PRODUCT	see FORMULATION.
ENVIRONMENTAL FATE	The result of natural processes acting upon a substance, including transport (e.g., on suspended sediment); physical transformation (e.g., volatilization, precipitation); chemical transformation (e.g., photolysis) and distribution among various media (e.g., living tissues).
EPIDEMIOLOGY	The study of relationships between the factors that determine the frequency and distribution of agents (including infectious diseases) in human or other animal populations. Epidemiologic toxicity information is based on medical experience in treatment of intoxication, rather than on results of planned experiments.

ESTIMATED ENVIRONMENTAL CONCENTRATIONS	Exposure point concentrations with specific reference to off-site transport via soil and surface water (e.g., based on application rates, formulated concentrations, rainfall, and soil porosity; also see EXPOSURE POINT CONCENTRATIONS).
EXPOSURE ASSESSMENT	Also EXPOSURE ANALYSIS; an evaluation of potential likelihood that humans, non-target wildlife, or biological habitats will be exposed to potentially harmful effects of a pesticide or other control method.
EXPOSURE PATHWAY	The route by which exposure to a toxicant occurs. A complete exposure pathway consists of contaminant source(s), transport media (e.g., surface water or soils), the contact point between the transport medium and the receptor (e.g., water supply system), and the receptor route or mechanism of entry (e.g., ingestion of water, biota, or inhaled dust). If an exposure pathway is incomplete, it does not warrant further consideration in the analysis.
EXPOSURE POINT CONCENTRATIONS	The pesticide concentration at the specific point of exposure; not necessarily at the site of application. (see ESTIMATED ENVIRONMENTAL CONCENTRATIONS)
EXPOSURE SCENARIO	Overall description of the potential contact of an organism or population with a wildlife damage management technique under specified conditions (i.e., routes of contact, life history of the organism, etc.).

F

FORMULATION	A pesticide product ready for application. Also refers to the process of manufacturing or mixing a pesticide product in accordance with the U.S. Environmental Protection Agency (EPA)-approved formula.
FREQUENCY	A criterion used in this EIS to evaluate the significance of impacts on target species abundance. Frequency refers to the distinction between continual and seasonal or intermittent control activity.
FUMIGANT	A chemical or chemical mixture, usually in liquid, gaseous, or solid form, that volatilizes to produce lethal fumes.

G

GEOGRAPHIC EXTENT	A criterion used in this EIS to evaluate the significance of ADC program impacts on target species abundance. Geographic extent refers to the percentage of states within a species range within which individuals of that species were killed.
GRANIVOROUS	Refers to seed or grain-eating animals.

H

HABITAT	An environment that provides the requirements (i.e., food, water, and shelter) essential to development and sustained existence of a species.
HABITAT IMPROVEMENT	Management of wildlife and fish habitats to increase their "carrying capacity" or ability to support specified kinds of wildlife or fish.
HABITAT MODIFICATION	Alteration of a habitat to maintain, increase, or decrease its ability to produce, support, or attract designated wildlife species.
HALF-LIFE ($T^{1/2}$)	The time necessary for the concentration of a chemical to decrease by 50 percent. Provides a measure of the persistence of a chemical in a given medium. The greater the half-life, the more persistent a chemical is likely to be.

HAZARD — Inherent toxicity or dangerous features of a wildlife damage control chemical or method. Intrinsic, potentially harmful or adverse effect of a wildlife damage management method; see RISK.

HAZARD EVALUATION SCREENING — A qualitative assessment of potential effects of wildlife damage management actions, such as trapping and pesticide use, conducted prior to a formal risk assessment.

HAZARD QUOTIENT (HQ) — Risk expressed as a ratio of dose (exposure) to toxicity for a specific exposure duration. HQ values are used to address both acute and chronic risk.

HENRY'S LAW CONSTANT — Provides a measure of the extent of chemical partitioning between air and water at equilibrium. The higher the constant, the more likely a chemical is to volatilize than to remain in solution.

HUMAN HEALTH RISK ASSESSMENT — Appraisal of the actual or potential effects of an wildlife damage management action on humans, such as workers or residents.

HYDROLYSIS — The decomposition of organic materials through a reaction with water.

I

INDICATOR SPECIES — A species thought to be representative of the well-being and reproductive success of other species in a particular habitat or community.

INDIGENOUS SPECIES — Any species of wildlife native to a given land or water area.

INTEGRATED PEST MANAGEMENT (IPM) — The process of integrating and applying practical methods of prevention and control to keep pest situations from reaching damaging levels while minimizing potentially harmful effects of pest control measures on humans, nontarget species, and the environment.

INTERSPECIES VARIABILITY — Measure of variable sensitivity between species used to adjust for uncertainty in defining toxicological benchmarks.

J

JEOPARDY/ JEOPARDIZE — To engage in an action that reasonably would be expected, directly or indirectly, to reduce the likelihood of both survival and recovery of a threatened or endangered species by reducing the reproduction, numbers, or distribution of that species.

L

LC_{50} (Lethal concentration 50 percent kill) — MEDIAN LETHAL CONCENTRATION; a calculated concentration of a substance expected to cause the death of 50 percent of the individuals in an experimental population. The concentration is determined by exposing a number of individuals from that population to various amounts of the substance in air, water, or bait and calculating the population parameter from mortality observed at the tested concentrations. This term is used in acute testing only; see CONCENTRATION.

LCL_o (Lethal Concentration Low) — The lowest recorded concentration of a substance that has caused death in humans or animals. The reported concentrations may be for periods of exposure less than 24 hours (acute) or greater than 24 hours (subacute or chronic).

LD_{50} (Lethal dose 50 percent kill) — MEDIAN LETHAL DOSE; a calculated dose of a substance expected to cause the death of 50 percent of the individuals in an experimental population. The dose is determined by exposing a number of individuals from that population to various doses of the substance by any route other than inhalation and calculating the population parameter from mortality observed at the tested doses. This term is used in acute testing only; see DOSE.

LDLo (Lethal Dose Low)	The lowest dose of a chemical that has caused death in humans or animals.
LETHAL CONTROL METHODS/ TECHNIQUES	Control methods or techniques that result in the death of animals (e.g., M-44s, aerial shooting, calling and ground shooting, and denning).
LIKELIHOOD	A criterion used in this EIS to assess the significance of impacts on target species abundance. Likelihood refers to the probability of control actions continuing to occur.
LOAEL	Lowest Observed Adverse Effect Level; the lowest exposure level tested at which there are statistically significant increases in frequency or severity of specific adverse effects among individuals of the test population when compared to the control population.
LOEC	Lowest Observed Effect Concentration; the lowest exposure level (concentration) at which there are any observable differences between the test and control populations.
LOEL	Lowest Observed Effect Level; the lowest exposure level (dose) at which there are any observable differences between the test and control populations.

M

"MAY AFFECT"	As used in this EIS, the potential for an action to impact an endangered or threatened species. "May Affect" determinations are part of the Endangered Species Act Section 7 Consultation Process.
MITIGATION	An action undertaken to avoid, minimize, rectify, reduce, or compensate for an adverse impact.
MUTAGENICITY	Capacity of a chemical to cause a permanent genetic change in a cell other than that which occurs during normal genetic recombination.

N

NOAEL	No Observed Adverse Effect Level; the highest exposure level tested at which there are no statistically significant increases in frequency or severity of specific adverse effects among individuals of the test population when compared to the control population.
NOEC	No Observed Effect Concentration; the highest concentration level tested at which there are no observable differences between the test and control populations.
"NO EFFECT"	As used in this EIS, a conclusion or opinion that an action will not impact an endangered or threatened species. "No Affect" determinations are part of the Endangered Species Act Section 7 Consultation Process.
NOEL	No Observed Observed Effect Level; the highest dose level at which there are no observable differences between the test and control populations.
NON-TARGET SPECIES/ANIMAL	An animal or local population that is inadvertently captured, killed, injured, or otherwise adversely affected by wildlife damage control activities directed toward target animals (see TARGET SPECIES/ANIMALS).

O

OCTANOL/WATER PARTITION COEFFICIENT (Kow)	A ratio that provides a measure of the extent of chemical partitioning between water and octanol at equilibrium. Octanol is used as a surrogate for lipids (e.g., fatty tissue or other organic substrate).
OFF-SITE TRANSPORT POTENTIAL	The ability for a compound to be transported off-site by various environmental factors (e.g., rain,erosion) and extend the contamination through other pathways to other receptors.

P

PARTITION COEFFICIENT	A chemical-specific property describing the ratio in one substrate or phase compared to another (e.g., the amount of a chemical adsorbed to sediment compared to the amount dissolved in water).
PEST	Any organism that damages or interferes with man's activities.
PESTICIDE	Any substance used for controlling, preventing, destroying, repelling, or mitigating any pest.
PHOTOLYSIS	Also PHOTODEGREDATION; The decomposition or dissociation of a molecule resulting from light (ultraviolet) absorption.
POPULATION	A group of organisms of the same species that occupies a particular area.
PREBAITING	Placement of untreated bait to precondition target wildlife to accept treated bait. Prebaiting is done before placement of some pesticides to enhance pesticide acceptance.
PREDATOR	An animal that kills and consumes another organisim (its prey).
PREY	An animal that is killed and consumed by a predator.
PRIMARY POISONING	Also PRIMARY TOXICITY; death or injury of target or non-target organisms that result from the direct consumption of, or exposure to, toxic substances in their originally applied form; see SECONDARY POISONING.
PROSPECTIVE EVALUATION	A predictive approach taken to evaluate potential non-target effects of pesticides based in part on past use pattern and exposure data.

Q

QUALITATIVE EVALUATION	A rigorous, subjective risk appraisal of a wildlife damage management action. Qualitative evaluations are normally used when sufficient data are lacking for use of mathematical (quantitative) methods.
QUANTITATIVE EVALUATION	An appraisal using mathematical techniques of the actual or potential effects of wildlife damage management actions on plants and/or animals other than humans.
QUANTITATIVE RISK ASSESSMENT (QRA)	Calculation of risk to nontarget species, workers, and the public from wildlife damage management actions identified by the screening process, with a determination of individual sources of uncertainty.

R

RAPTORS	Carnivorous bird species (e.g., owls, hawks, falcons) that prey on other birds, amphibians, reptiles, and mammals.
RECEPTORS/ RECEPTOR POPULATION	Organisms or groups of organisms potentially exposed to a pesticide or other toxicant.
REPELLENT	A substance with a taste, odor, or feel that discourages a specific animal or species from using a food or place.
RESIDENT SPECIES	Animal species that do not normally migrate in response to seasonal changes and are generally managed by state agencies.
RESTRICTED USE PESTICIDE	A pesticide that has been classified by EPA or an appropriate state agency as possessing the potential to cause adverse effects on the environment when not applied in ac-

cordance with label use restrictions. Restricted use pesticides can only be applied by or under the supervision of a certified applicator.

RETROSPECTIVE EVALUATION An empirical evaluation of past use pattern and exposure data (e.g., kill or "take" data) used to forecast potential non-target effects of pesticides.

RISK A potential adverse effect associated with exposure to a wildlife damage management action or methods. Hazard plus exposure defines risk.; see HAZARD.

RODENTICIDE A toxicant specifically designed to kill rodent species.

ROOST/ROOSTING SITE A place where birds congregate for resting or sleeping. Roosts are commonly located in trees, shrubbery, aquatic vegetation, certain agricultural crops, and manmade structures.

S

SCAVENGER An animal that habitually feeds on refuse or carrion.

SCREENING PROCEDURE A preliminary review of exposure potential, use patterns, and hazards of wildlife damage management actions to identify those that may pose a potential risk when used in accordance with recommended practices; see HAZARD, RISK.

SEASONALITY Variation or differences caused by, or associated with, different seasons of the year.

SECONDARY POISONING Also SECONDARY TOXICITY; intoxication resulting from feeding on the carcass or gastrointestinal tract contents of a primary victim that died from ingestion of toxic materials; see PRIMARY POISONING.

SECTION 7 CONSULTATION A provision under Section 7 of the Endangered Species Act requiring consultation between Federal agencies and the USFWS. The Federal agency identifies all potential impacts to threatened and endangered species that a particular activity might cause. The Federal agency ensures its actions are not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat (see BIOLOGICAL OPINION).

SEDIMENT-WATER DISTRIBUTION COEFFICIENT (Kd) The ratio of the amounts of a chemical adsorbed to sediments and dissolved in water. The higher the Kd value, the more likely the chemical will adsorb to the sediments than remain dissolved in water.

SEDIMENT-WATER PARTITION COEFFICIENT (Koc) An indication of the relative tendency for chemicals to adsorb to organic sediments or soil particles. The higher the Koc, the more likely a chemical is to bind to soil or sediment than to remain in solution.

SOLUBILITY The mass of a dissolved substance that will saturate a fixed volume of a solvent under static conditions.

SOPORIFIC A control agent intended to dull awareness or alertness in the target species for ease in removal.

SORPTION A generalized term referring to both adsorption and desorption.

SPECIES DIVERSITY See DIVERSITY.

SPECIFIC GRAVITY The parameter indicating whether a chemical will sink or float in water, which aids in identifying a chemical's distribution and movement when in high concentrations in surface water or groundwater.

STRESSING AGENT A substance which places demands on the physiology of an organism and which may result in increased susceptibility to debilitation or death.

SUBCHRONIC TOXICITY Adverse biologic response of an organism, such as mortality or an effect on growth or reproductive success, resulting from repeated or short term (months) exposures to a compound (usually at low concentrations); see ACUTE TOXICITY, CHRONIC TOXICITY.

SURFACTANT A surface active agent that reduces surface tension, such as a detergent or emulsifier.

SURROGATE SPECIES — A substitute species that can be compared with a lesser known or more rare species.

SYNERGISTIC EFFECTS — The result of combined action of 2 or more substances or agencies to achieve an effect greater than that of which each is individually capable.

T

TAKE — The capture or killing of an animal.

TARGET SPECIES/ANIMAL/ POPULATION — An animal or local population to which wildlife damage control activities are directed to alleviate damage to agricultural and nonagricultural resources or prevent hazards to public health and safety. Any animal species may be either a target or nontarget, depending on the situation.

TECHNICAL ASSISTANCE — Advice, recommendations, information, and materials provided by ADC program employees for others to use in managing wildlife damage problems (see DIRECT CONTROL).

TERATOGENESIS — Birth defects caused by outside agents, such as toxicants, acting during gestation; interference with normal embryonic development.

TERRESTRIAL WILDLIFE — Organisms residing on land for all or part of their life cycle.

THREATENED SPECIES — Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

TOXICANT — A poison or poisonous substance.

TOXICITY — Capacity of a chemical to induce an adverse effect.

TOXICOLOGICAL BENCHMARK — A guideline value derived as a measure of sensitivity to acute or chronic exposure for the purpose of protecting wildlife; may be derived for either individual species or species groups.

TOXICOLOGICAL EVALUATION — An assessment of the potential adverse effects of specific compounds of interest.

TSS — Total Suspended Solids.

U

UNCERTAINTY — Inherent error resulting from any analysis of data.

UNCERTAINTY ANALYSIS — Estimation of inherent error resulting from any analysis using environmental or other data. Uncertainty analysis is a technique that attempts to quantify relative sources and magnitudes of uncertainty within the analysis.

UNCERTAINTY FACTOR — Quantifying relative uncertainty used for deriving toxicological benchmarks (data quality, interspecies variability, endpoint sensitivity, and endpoint extrapolation).

USE PATTERN — The pattern of use for any specific pesticide product or wildlife damage control method, including how the method is applied, and the rates, frequency, and timimg of application.

V

VADOSE ZONE — The unsaturated zone of the soil, generally above the water table.

VAPOR PRESSURE — The pressure exerted by a chemical vapor in equilibrium with its solid or liquid form at a given temperature.

VOLATILIZATION — Phase conversion of a liquid or solid into vapor.

W

WATER SOLUBILITY The parameter that helps identify a chemical's mobility in water media. The more soluble a chemical, the quicker it will be distributed through the hydrologic cycle.

WETTABLE POWDER A pesticide formulation of toxicant that mixes readily with water and forms a short-term suspension. Complete mixing of the toxicant often requires tank agitation.

WHOLE-BODY DOSE The total amount of substance given or applied to an animal; see DOSE.

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Appendix Q

EPA-Approved Registrations for Pesticides Used in the APHIS Animal Damage Control Program

Appendix Q

EPA-Approved Registrations for Pesticides Used in the APHIS Animal Damage Control Program

Table of Contents

Introduction

Pesticides are authorized for use under four sections of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Most products are registered under FIFRA Section 3. Research to develop and evaluate new materials is conducted under experimental use permits (Section 5). Pest control emergencies that necessitate use of unregistered products may be authorized under Section 18. State and local need (SLN) registrations are issued under Section 24(c), and are limited to authorization of expanded uses for products already registered under Section 3.

Labels for FIFRA Section 3 registrations held by the Animal and Plant Health Inspection Service (APHIS) during fiscal years (FY) 1988 through 1991 appear in Part I of this appendix. SLN registrations and experimental use permits are listed in Part II. Parts I and II include all registrations held by APHIS during FY 1988 through 1991 even though some of these products were not used during that period.

In addition to pesticide products registered by APHIS, the Animal Damage Control (ADC) program uses, supervises the use of, recommends or distributes some commercially registered products. Registrations for these commercially registered materials are listed in Part III.

All pesticide registrations under FIFRA are administered by the U.S. Environmental Protection Agency (EPA). In addition to registered pesticides, the APHIS ADC program also uses several drugs that are regulated by the U.S. Food and Drug Administration (FDA) as shown in Parts II and III of this Appendix.

Part A

Product Labels for FIFRA Section 3 Registrations Held by U.S. Department of Agriculture Animal and Plant Health Inspection Service Animal Damage Control

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

WARNING

After ignition, cartridge produces toxic gases . Fumes may be harmful if inhaled.

ENVIRONMENTAL HAZARDS

This product is highly toxic to wildlife. Check all burrows for signs of nontarget species. If present, do not treat burrows.

CHEMICAL HAZARDS

Once ignited by the fuse, this cartridge will burn vigorously until completely spent and is capable of causing severe burns to exposed skin and clothes, and of igniting dry grass, leaves and other combustible materials.

ENDANGERED SPECIES CONSIDERATIONS

NOTICE: It is a Federal offense to use any pesticide in a manner that results in the death of a member of an endangered species.

Black-Footed Ferret: Do not use this product in the range of the black-footed ferret. Contact the nearest U.S. Fish and Wildlife Service office (Endangered Species Specialist) before the product is used. They will arrange for a survey of the proposed use site.

Utah Prairie Dog: Do not use this product in the range of the Utah prairie dog. (Utah)

San Joaquin Kit Fox: This pesticide should not be used within 1 mile of active dens of the San Joaquin kit fox in the following California counties: Kern, Kings, Fresno, San Luis, Obispo, Merced, Monterey, Santa Barbara, Ventura, Tulare, and San Benito. Prior to use, contact the California Department of Fish and Game for recommendations.

Blunt-Nosed Leopard Lizard: This pesticide should not be used in the range of the blunt-nosed leopard lizard in the following California counties: Kern, Fresno, Kings, Madera, Merced, and Tulare. Prior to use, contact the California Department of Fish and Game for recommendations.

Eastern Indigo Snake: Do not use this product in the range of the eastern indigo snake in the following states: Mississippi, Alabama, South Carolina, Georgia, and Florida.

Desert Tortoise: This pesticide should not be used in the critical habitat of the Beaver Dam slope population of the desert tortoise in Utah. This comprises an area extending from the southwest facing slope of the Beaver Dam Mountains, across Highway 91, west along the Arizona border and 10 miles to the Nevada border.

GAS CARTRIDGE

For control of woodchucks, ground squirrels, prairie dogs and pocket gophers.

NOT FOR SALE TO PERSONS UNDER 16 YEARS OLD

ACTIVE INGREDIENTS:	
Sulphur	10.84%
Charcoal	17.34%
Red Phosphorus	3.25%
Mineral Oil	14.09%
Sodium Nitrate	43.36%
Sawdust	3.52%
Total	92.40%
INERT INGREDIENTS:	
Borax	3.25%
Fullers Earth	4.35%
Total	7.60%
TOTAL	100.00%

KEEP OUT OF REACH OF CHILDREN

WARNING

STATEMENT OF PRACTICAL TREATMENT

CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

If inhaled and person has poisoning symptoms (headache, nausea, dizziness, weakness), transfer victim to fresh air. Have victim lie down and keep warm. If respiration is adequate, recovery will be rapid. If breathing has stopped, use artificial respiration. If available, pure oxygen should be given.

SEE LEFT SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-2

Net Weight 85 grams

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store in cool, dry place away from fire, heat and direct sunlight.

PESTICIDE DISPOSAL: To dispose of unused cartridges, soak in water, crush and bury at least 6" in loose soil.

CONTAINER DISPOSAL: Place in trash collection.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS

For control of woodchucks, ground squirrels, prairie dogs, and pocket gophers in open fields, non-crop areas, rangelands, reforested areas, lawns, and golf courses. For use only inside of burrows. Do not use near flammable material or inside buildings.

APPLICATION DIRECTIONS

Select burrow for treatment and obtain material to plug the entrance. Then, with a nail at least 1/8" in diameter, puncture cap at end of cartridge at points marked. Insert fuse in one of center holes. Insure that there is a minimum of 3 inches of exposed fuse. Hold cartridge away from face and body, then light.

NOTE: The minimum burn time for these fuses is 5 seconds.

Place cartridge, fuse-end first, as far into the burrow as possible. Close entrance to burrow immediately.

REFER TO BACK PANEL FOR TARGET-SPECIFIC DIRECTIONS FOR USE.

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DIRECTIONS FOR USE *(Continued)*

TARGET-SPECIFIC DIRECTIONS FOR USE

WOODCHUCKS: Locate all burrow entrances if possible. Select one for treatment and close all others with rock and soil. Light fuse and insert cartridge fuse-end first. Cover opening with rock and soil, being careful not to smother cartridge. Consult state game laws before using this product for woodchuck control.

GROUND SQUIRRELS and PRAIRIE DOGS: Collect soil and other material to close burrow openings. Treat each burrow opening by lighting fuse and inserting cartridge into burrow, fuse-end first (make sure burrow is large enough for easy insertion of cartridge before lighting fuse). Cover burrow immediately, taking care not to smother cartridge with loose soil. Immediately cover all nearby cracks in soil or openings from which gas escapes. Proceed to nearest open burrow and follow same procedure.

POCKET GOPHERS: Locate fan-shaped soil mounds with signs of recent activity. Find the horseshoe-shaped depression on one side of the mound. To locate the main runway, probe ground 15-18 inches from mound on the same side as depression. The main runway has been located when friction on probe is released and it falls into runway. Dig down to main runway, taking care to not block it with soil. Locate an opening large enough for easy insertion of the cartridge. Collect enough soil and other material to close opening. Light fuse and insert cartridge fuse-end first. Immediately cover opening, taking care not to smother cartridge with loose soil. Cover all nearby cracks in soil where gas escapes. Treat all active mounds.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

WARNING

After ignition, cartridge produces the toxic gas, carbon monoxide. Fumes may be harmful if inhaled.

ENVIRONMENTAL HAZARDS

This product is highly toxic to wildlife. Check all burrows for signs of nontarget species. If present, do not treat burrows.

CHEMICAL HAZARDS

Once ignited by the fuse, this cartridge will burn vigorously until completely spent and is capable of causing severe burns to exposed skin and clothes, and of igniting dry grass, leaves and other combustible materials.

ENDANGERED SPECIES CONSIDERATIONS

NOTICE: It is a Federal offense to use any pesticide in a manner that results in the death of a member of an endangered species.
Do not use in those areas where the following Endangered Species may be known to have dens: red wolf, gray wolf, and San Joaquin kit fox.

GAS CARTRIDGE FOR COYOTES

For control of coyotes (Canis latrans) in dens only.

NOT FOR SALE TO PERSONS UNDER 16 YEARS OLD

ACTIVE INGREDIENTS:

Sodium Nitrate	65.0%
Charcoal	35.0%
TOTAL	100.0%

KEEP OUT OF REACH OF CHILDREN
WARNING

STATEMENT OF PRACTICAL TREATMENT

CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

If inhaled and person has poisoning symptoms (headache, nausea, dizziness, weakness), transfer victim to fresh air. Have victim lie down and keep warm. If respiration is adequate, recovery will be rapid. If breathing has stopped, use artificial respiration. If available, pure oxygen should be given.

SEE LEFT SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-21

Net Weight 240 grams

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store in cool, dry place away from fire, heat and direct sunlight.

PESTICIDE DISPOSAL: To dispose of unused cartridges, soak in water, crush and bury at least 6" in loose soil.

CONTAINER DISPOSAL: Place in trash collection.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS

For control of coyotes *(Canis latrans)* in dens only on rangelands, and crop and non-crop areas. Do not use near flammable material or inside buildings.

APPLICATION DIRECTIONS

First select den for treatment. Make sure cartridge will pass easily into opening and obtain material to plug the entrance. Then, with a nail at least 1/8" in diameter, puncture cap at end of cartridge at points marked. Insert fuse in one of center holes. Insure there is a minimum of 3 inches of exposed fuse. Hold cartridge away from face and body, then light.

NOTE: The minimum burn time for these fuses is 5 seconds.

Place cartridge, fuse-end first, as far into the entrance as possible. Close entrance to burrow immediately. (If burrow is steep, contents of cartridge may flow out of lighted end. If so, place cartridge as deep in burrow as possible with fuse-end up, light, and close burrow.

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PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Harmful if swallowed, inhaled, or absorbed through the skin. Avoid contact with eyes, skin, or clothing. Handle only with protective gloves, clothing, and face mask, or respirator. Wash hands with soap and water after handling.

ENVIRONMENTAL HAZARDS

This product is toxic to birds. Do not expose in areas accessible to waterfowl, poultry, and other non-target birds. Keep out of lakes, ponds, streams, tidal marshes, and estuaries. Do not apply where runoff is likely to occur. Do not contaminate water by the cleaning of equipment or disposal of waste.

ENDANGERED SPECIES CONSIDERATIONS

Before undertaking any control operations with the product, consult with local, State, and Federal wildlife authorities to ensure the use of this product presents no hazard to any endangered species.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

GENERAL INFORMATION: Compound DRC-1339 Concentrate is a slow acting avicide for the control of blackbirds, cowbirds, grackles, and starlings. Birds ingesting treated bait(s) die within one to three days.

USE RESTRICTIONS

Application of treated bait(s) in any problem area should be made only after careful observation of bird feeding habits to locate preferred feeding sites, determine the optimum time of application, and evaluate hazards of the application to desirable or protected animals. DO NOT apply bait(s) in areas where there is danger of consumption by endangered species. Prebaiting may be necessary to obtain successful results. When baiting is completed, remove all unconsumed bait material and dispose of in accordance with applicable state or federal laws. Carcasses of dead or dying birds that are found should be collected and either burned or buried according to applicable laws.

NOTE: WHEN CONTROLLING BLACKBIRDS, COWBIRDS, AND GRACKLES. IT MAY BE NECESSARY TO OBTAIN A KILL-PERMIT FROM THE U.S. FISH AND WILDLIFE SERVICE AND/OR THE APPLICABLE STATE WILDLIFE AGENCY.

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

For use only by U.S. Department of Agriculture personnel trained in bird control or persons under their direct supervision.

COMPOUND DRC-1339
98% CONCENTRATE

ACTIVE INGREDIENT:
3-Chloro-p-toluidine hydrochloride 98.0%
INERT INGREDIENTS: 2.0%
TOTAL 100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

IF SWALLOWED: Induce vomiting and immediately call a physician.
IF INHALED: Move patient from contaminated area and immediately call a physician.
IF ON SKIN OR IN EYES: Immediately flush eyes or skin with large quantities of water. Call a physician immediately.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-10

Net Weight

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment, then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities. If burned, stay out of smoke.

DIRECTIONS FOR USE *(Cont.)*

Brewers blackbird (*Euphagus cyanocaphalus*)
Brownheaded cowbird (*Molothrus ater*)
Common grackle (*Quisculus quiscula*)
Great-tailed grackle (*Cassidix mexicanus*)
Red-winged blackbird (*Agelaius phoeniceus*)
Starling (*Sturnus vulgaris*)

FOR CONTROL IN FEEDLOTS

FORMULATION DIRECTIONS: Dissolve 46 grams (1.6 oz) of Compound DRC-1339 Concentrate in 600 ml (1.3 pt) of warm potable water or edible oil (the amount can be adjusted according to the bait material used to obtain uniform coverage). Pour the solution over 4.5 kg (10 lbs) of bait material and mix or tumble slowly until mixture appears evenly distributed and dry. Bait may consist of poultry pellets, rice, corn, or milo. Do not use bait materials that have less than 2500 particles/lb or more than 25,000 particles/lb.

Dilute treated baits with 5 to 10 parts of similar, untreated bait. Baits prepared in this manner should reduce the possibility of target birds consuming more than one lethal bait and should allow more birds an opportunity to consume a lethal bait.

APPLICATION IN BEEF CATTLE FEEDLOTS: Place by hand in feeding stations or scatter by hand diluted bait thinly and uniformly at a rate of 2.5kg/100m^2 (1lb/1000ft^2) over dry or frozen areas in pens and alleyways before target birds arrive in the morning. Pens occupied by beef cattle are particularly attractive to feeding birds.

APPLICATION IN POULTRY AND SWINE FEEDLOTS: Place in feeding stations or hand scatter baits thinly and uniformly over dry or frozen areas at a rate of 2.5kg/100m^2 (1lb/1000ft^2)on the PERIMETER of the lot OUTSIDE the pen areas occupied by poultry and swine. Do not bait occupied pens.

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PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Harmful if swallowed, inhaled, or absorbed through the skin. Contact with eyes may cause a severe reaction. Handle only with protective gloves and clothing. Use a face mask or respirator which are aproved by the Mining Enforcement and Safety Administration and the National Institute for Occupational Safety and Health. Wash hands thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse.

ENVIRONMENTAL HAZARDS

This product is toxic to birds. Do not expose in areas accessible to waterfowl, poultry, and other non-target birds. Keep out of lakes, ponds, streams, tidal marshes, and estuaries. Do not apply where runoff is likely to occur. Do not contaminate water when disposing of equipment washwaters.

ENDANGERED SPECIES CONSIDERATIONS

Before undertaking any control operations with the product, consult with local, State, and Federal wildlife authorities to ensure the use of this product presents no hazard to any endangered species.

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

For use only by U.S. Department of Agriculture personnel trained in bird control or persons under their direct supervision.

1339 GULL TOXICANT 98% CONCENTRATE

ACTIVE INGREDIENT: 3-Chloro-4-methyl benzenamine hydrochloride ...	98.0%
INERT INGREDIENTS:	2.0%
TOTAL	100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

IF SWALLOWED - Induce vomiting by touching the back of the throat with finger. Call a physician immediately.
IF INHALED - Move patient from contaminated area and immediately call a physician.
IF ON SKIN OR IN EYES - Immediately flush eyes or skin with large quantities of water. Call a physician immediately.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-17

Net Weight .

3/89

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities. If burned, stay out of smoke.

DO NOT USE TREATED BREAD AS FOOD OR FEED

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS: Use 1339 Gull Toxicant 98% Concentrate for preparing bread baits to control herring gulls *(Larus argentatus)*, great black-backed gulls (Larus marinus), and ring-billed gulls *(Larus delawarensis)* only. Apply only in coastal breeding areas or colonies within predation radius of important nesting colonies of terns, puffins, laughing gulls, or other colonial nesting birds from March 1 to June 30 each year.
BAIT PREPARATION: Blend 0.2 oz. (6 gms.) 1339 Gull Toxicant 98% Concentrate into 1 lb. (454 gms.) melted, stick oleomargarine. Spread 1/2 oz. (15 gms.) of blended mixture (1 tablespoon) on a slice of standard sandwich bread and cover with another slice. Immediately cut each sandwich into 9 equally-sized cubes. Prepared baits must be placed in a plastic bag marked "POISON" for transportation or distribution and must be used within 12 hours.
PRETREATMENT: Each site destined to be treated will be prebaited with untreated bread cubes to insure rapid bait acceptance.
TREATMENT: Treatments will be made by hand only in or near nesting colonies of the target species. Treated bread cubes will be hand broadcast or placed only in the same areas where bread cubes were accepted during prebaiting. Initial applications will be hand broadcast; however, no hand broadcast application will be made after April 20. Application after April 20 will be made by hand placement at or in gull nests. The number of bait applications will be determined by the degree of control provided by previous applications; however, no more than 10 bait applications should be made in or near individual colonies. The number of baits exposed at an individual site must not exceed 5 times the total number of gulls to be controlled at that location.
POST TREATMENT: Baits regurgitated or not accepted must be retrieved within 12 hours after each application and disposed of by burial or other adequate means. A search must be conducted within 48-72 hours after application to remove and dispose of bird carcasses, except for those areas where disturbances of non-target species may adversely affect their breeding efforts.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

CORROSIVE. CAUSES EYE DAMAGE and skin irritation. Keep out of eyes, keep off skin and clothing. Wear goggles or face shield and rubber gloves when handling. Harmful if swallowed. Avoid food contamination. Keep all unprotected persons out of the operating area or vicinity where there may be danger of drift.

ENVIRONMENTAL HAZARDS

This product is toxic to wildlife and other aquatic life at recommended application rates. Keep out of lakes, streams, ponds, and estuaries. Apply this product only as specified on this labeling.

ENDANGERED SPECIES CONSIDERATIONS

.Notice: The killing of a member of an endangered species during roost treatment may result in a fine under the Endangered Species Act. Before treatment, the user is advised to contact the Regional U.S. Fish and Wildlife Service (Endangered Species Specialist) or the local Fish and Game Office for specific information on endangered species.

RESTRICTED USE PESTICIDE

For use only by or under the supervision of persons certified as applicatores of Restricted Use Pesticides. Use of this product in avian population control is limited to situations approved and supervised by U.S. Department of Agriculture personnel trained in bird control.

COMPOUND PA-14 AVIAN STRESSING AGENT

For the control of roosting red-winged blackbirds, rusty blackbirds, common grackles, brown-headed cowbirds, and starlings.

ACTIVE INGREDIENTS:

a-Alkyl (C_{11}-C_{15}) -omega-hydroxpoly (oxyethylene): average poly (oxyethylene) content 9 moles* ... 99.5%

INERT INGREDIENTS:

Water 0.5%

TOTAL 100.0%

*ethoxylate of isomeric linear secondary alcohol

KEEP OUT OF REACH OF CHILDREN

DANGER

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

Promptly administer a large quantity of milk, egg white, or gelatin so these are not available, administer large quantities of water. Avoid alcoh

IF IN EYES - Flush eyes with plenty of water. Call a physician immed

IF ON SKIN - Remove contaminated clothing, and flush affected ar plenty of water.

NOTE TO PHYSICIAN

Probable mucosal damage may contraindicate the use of gastric Measures against circulatory shock, respiratory depression, and convul be needed.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-13

Net Weight 55 GALLONS LIQUID (460 lbs.)

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS

For use directions, see "Instructions for Use of PA-14 Avian Stressing Agent". Do not use without reading instructions. For further information write to the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Hyattsville, MD 20782.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store in original container in a dry location at temperature below 50° C (122° F). In case of leakage or spills flush with water or cover with absorbent materials.

PESTICIDE DISPOSAL: Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Sodium Cyanide may be fatal if swallowed or inhaled. Use only with adequate ventilation and do not breathe the gas or dust. When handling, setting out or checking M-44 cyanide capsules, always have at least six pearls of Amyl-Nitrite readily available in case sodium cyanide is swallowed or inhaled.

While handling sodium cyanide capsules, protect hands with gloves and shield eyes to prevent eye burns and skin irritation. Wash thoroughly before eating or smoking.

Do not use in areas frequented by humans or domestic dogs.

ENVIRONMENTAL HAZARDS

This pesticide is TOXIC TO WILDLIFE. Keep out of lakes, ponds or streams. Do not contaminate water by cleaning of equipment or disposal of wastes. The M-44 ejector device cannot be used in areas inhabitated by endangered canids and felids.

CHEMICAL HAZARDS

Contact with acid liberates poisonous and flammable hydrogen cyanide gas.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

For use in specific situations to reduce canids (coyotes, red fox, gray fox and wild dogs) that depredate livestock and poultry or federally designated threatened or endangered species. For use on pastures, range land and forest land only. Do not place in areas where food crops are planted.

IMPORTANT - Before handling or placing M-44 cyanide capsules or M-44 ejector devices, consult the Use Restriction Bulletin for specific use directions, additional precautions, information on endangered species, warning signs and antidotal measures.

WARNING SIGNS
Bilingual (Spanish/English) warning signs must be posted in the general area and at the application site.

RESTRICTED USE PESTICIDE

For retail sale to and use only by certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

M-44 CYANIDE CAPSULES

For use in the M-44 ejector device to control coyotes (Canis latrans), red fox (Vulpes vulpes), gray fox (Urocyon cinereoargenteus) and wild dogs that depredate livestock and poultry or federally designated threatened or endangered species.

ACTIVE INGREDIENT:
Sodium Cyanide 88.62%
INERT INGREDIENTS: 11.38%
TOTAL : 100.00%

50 Capsules Net Weight 45.5 grams

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

IF SWALLOWED OR INHALED - Prompt treatment is of the utmost importance. Carry patient to fresh air, have him lie down. Patient should breathe the contents of an Amyl Nitrite pearl 15-30 seconds each minute if necessary, until five pearls have been used. Use artificial respiration if breathing has stopped. Remove contaminated clothing, but keep patient warm. CALL A PHYSICIAN IMMEDIATELY.

IF ON SKIN - Immediately flush with plenty of water.

IF IN EYES - Immediately flush with plenty of water and call a physician.

SEE LEFT SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
NATIONAL TECHNICAL SUPPORT STAFF/ADC
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-15

STORAGE AND DISPOSAL

STORAGE: Store M-44 cyanide capsules under lock and key in a dry place away from food, domestic animals and acids. Do not contaminate feed or food stuffs.

DISPOSAL: Dispose of defective and used M-44 capsules by burial in a safe location in the field or at a proper land fill site.

M-44 Cyanide Capsules
M-44 Use Restrictions
EPA Registration No. 56228-15

1. Use of the M-44 device shall conform to all applicable Federal, State, and local laws and regulations.

2. Applicators shall be subject to such other regulations and restrictions as may be prescribed from time-to-time by the U.S. Environmental Protection Agency (EPA).

3. Each applicator of the M-44 device shall be trained in: (1) safe handling of the capsules and device, (2) proper use of the antidote kit, (3) proper placement of the device, and (4) necessary recordkeeping.

4. M-44 devices and sodium cyanide capsules shall not be sold or transferred to, or entrusted to the care of any person not supervised or monitored, by the Animal and Plant Health Inspection Service (APHIS), Animal Damage Control (ADC) program or any agency not working under an ADC cooperative agreement.

5. The M-44 device shall only be used to take wild canids suspected of preying on livestock, poultry or federally designated threatened or endangered species.

6. The M-44 device shall not be used solely to take animals for the value of their fur.

7. The M-44 device shall only be used on or within 7 miles of a ranch unit or allotment where losses due to predation by wild canids are occurring or where losses can be reasonably expected to occur based upon recurrent prior experience of predation on the ranch unit or allotment. Full documentation of livestock depredation, including evidence that such losses were caused by wild canids, will be required before applications of the M-44 is undertaken.

8. The M-44 device shall not be used: (1) In areas within national forests or other Federal lands set aside for recreational use, (2) areas where exposure to the public and family and pets is probable, (3) in prairie dog towns, or, (4) except for the protection of federally designated threatened or endangered species, in National and State Parks; National or State Monuments; federally designated wilderness areas; and wildlife refuge areas.

9. The M-44 device shall not be used in areas where federally listed threatened or endangered animal species might be adversely affected. Each applicator shall be issued a map, prepared by or in consultation with the U.S. Fish and Wildlife Service, which clearly indicates such areas.

10. One person other than the individual applicator shall have knowledge of the exact placement location of all M-44 devices in the field.

M-44 Cyanide Capsules
M-44 Use Restrictions
EPA Registration No. 56228-15

11. In areas where more than one governmental agency is authorized to place M-44 devices, the agencies shall exchange placement information and other relevant facts to ensure that the maximum number of M-44's allowed is not exceeded.

12. The M-44 device shall not be placed within 200 feet of any lake, stream, or other body of water, provided that natural depression areas which catch and hold rainfall only for short periods of time shall not be considered "bodies of water" for purposes of this restriction.

13. The M-44 device shall not be placed in areas where food crops are planted.

14. The M-44 device shall be placed at least at a 50-foot distance or at such a greater distance from any public road or pathway as may be necessary to remove it from the sight of persons and domestic animals using any such public road or pathway.

15. The maximum density of M-44's placed in any 100 acre pastureland area shall not exceed 10; and the density in any 1 square mile of open range shall not exceed 12.

16. No M-44 device shall be placed within 30 feet of a livestock carcass used as a draw station. No more than four M-44 devices shall be placed per draw station and no more than five draw stations shall be operated per square mile.

17. Supervisors of applicators shall check the records, warning signs, and M-44 devices of each applicator at least once a year to verify that all applicable laws, regulations, and restrictions are being strictly followed.

18. Each M-44 device shall be inspected by the applicator at least once every week, weather permitting access, to check for interference or unusual conditions and shall be serviced as required.

19. Damaged or nonfunctional M-44 devices shall be removed from the field.

20. An M-44 device shall be removed from an area if, after 30 days, there is no sign that a target predator has visited the site.

21. All persons authorized to possess and use sodium cyanide capsules and M-44 devices shall store such capsules and devices under lock and key.

22. Used sodium cyanide capsules shall be disposed of by deep burial or at a proper landfill site.

23. Bilingual warning signs in English and Spanish shall be used in all areas containing M-44 devices. All such signs shall be removed when M-44 devices are removed.

a. Main entrances or commonly used access points to areas in which M-44 devices are set shall be posted with warning signs to alert the public to the toxic nature of the cyanide and to the danger to pets. Signs shall be inspected weekly to ensure their continued presence and ensure that they are conspicuous and legible.

b. An elevated sign shall be placed within 25 feet of each individual M-44 device warning persons not to handle the device.

24. Each authorized or licensed applicator shall carry an antidote kit on his person when placing and/or inspecting M-44 devices. The kit shall contain at least six pearls of amyl nitrite and instructions on their use. Each authorized or licensed applicator shall also carry on his person instructions for obtaining medical assistance in the event of accidental exposure to sodium cyanide.

25. In all areas where the use of the M-44 device is anticipated, local medical people shall be notified of the intended use. This notification may be through a poison control center, local medical society, the public health service, or directly to a doctor or hospital. They shall be advised of the antidotal and first-aid measures required for treatment of cyanide poisoning. It shall be the responsibility of the supervisor to perform this function.

26. Each authorized M-44 applicator shall keep records dealing with the placement of the device and the results of each placement. Such records shall include, but need not be limited to:

a. The number of devices placed.

b. The location of each device placed.

c. The date of each placement, as well as the date of each inspection.

d. The number and location of devices which have been discharged and the apparent reason for each discharge.

e. Species of animals taken.

f. All accidents or injuries to humans or domestic animals.

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Animal Damage Control
National Technical Support Staff
Hyattsville, MD 20782
May 13, 1988

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

May be fatal if swallowed. Wear waterproof gloves when handling collars. Wash hands after handling collars or animals that have been contaminated with 1080 solution. Do not use contaminated animals for food or feed

ENVIRONMENTAL HAZARDS

This pesticide is very highly toxic to wildlife. Birds and mammals feeding on carcasses of contaminated livestock may be killed. Keep out of any body of water. Apply this product only as specified on this label.

ENDANGERED SPECIES CONSIDERATIONS

NOTICE: It is a Federal offense to use any pesticide in a manner that results in the death of a member of an endangered species.
The use of 1080 in the Livestock Protection Collar has been determined to pose a hazard to several endangered species. See technical bulletin (use restriction No. 15) for specific areas where the 1080 collar cannot be used or approval must be obtained from the U.S. Fish and Wildlife Service prior to use.

NOTE TO PHYSICIAN

WARNING SYMPTOMS: 1080 poisioning results from the transformation of fluoroacetate into fluorocitrate within cell mitochondria. Poisoning is characterized by a symptom-free latent period of 1/2 to 2 hours or longer between ingestion and onset of symptoms (nausea, vomiting, diarrhea, and hyperactive behavior leading to convulsions, coma, and cyanosis). Ventricular fibrillation is commonly noted and is the primary cause of death. Early symptoms include alteration of heart sounds and premature, weak contractions.

TREATMENT: No effective antidote is known but symptomatic treatment may be effective. Establish respiration; create artificial airway if necessary. Check adequacy of tidal volume. Initiate emesis. If patient is comatose, convulsing, or has lost the gag reflex, endotracheal intubation should precede gastric lavage with large bore tube. Administer activated charcoal and magnesium sulfate. Treat seizures with IV diazepam. Monitor cardiac function closely. Treatment with glyceryl monoacetate (monoacetin) may be effective; however, it is experimental and unproven in humans. CONSULT NEAREST POISON CONTROL CENTER FOR CURRENT INFORMATION. Symptoms of non-lethal intoxication will usually subside within 12-24 hours.

RESTRICTED USE PESTICIDE

Collars shall be sold or transferred only by registrants or their agents and only to certified Livestock Protection Collar applicators. Collars may be used only by specifically certified Livestock Protection Collar applicators or by persons under their direct supervision.

SODIUM FLUOROACETATE (COMPOUND 1080) LIVESTOCK PROTECTION COLLAR

For use on sheep or goats to kill depredating coyotes

ACTIVE INGREDIENT:	
Sodium fluoroacetate	1.00%
INERT INGREDIENTS:	99.00%
TOTAL	100.00%

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

IF SWALLOWED: Induce vomiting at once with an emetic such as syrup of ipecac: use as directed. If emetic is not available, drink 1-2 glasses of water and induce vomiting by touching back of throat with finger. Do not induce vomiting or give anything by mouth to an unconscious person. PROMPT TREATMENT IS MANDATORY. GET MEDICAL ATTENTION IMMEDIATELY.
IF ON SKIN - Wash the exposed area twice with soap and water.
IF IN EYES - Wash eyes with plenty of water for at least 15 minutes.
IF ON CLOTHING - Remove contaminated clothing and wash before re-use. Dispose of all contaminated leather, including shoes, boots, and gloves; according to the pesticide Disposal Section. See disposal instruction on side panel.

SEE LEFT SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

MANUFACTURED BY: UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
Hyattsville, MD 20782

U.S. PAT. 3,842,806 EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-22

NET CONTENTS: 30.4 grams (1.1 oz.) per small collar

NOTICE

Seller makes no warranty, expressed or implied, concerning the use of this product other than that indicated on the label. Buyer assumes all risk of use and/or handling of this material when such use and/or handling is contrary to label instructions

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store Livestock Protection Collars only in original container, in a dry, locked place away from food, feed, domestic animals and corrosive chemicals. Do not store in any structure occupied by humans.

When snow or frozen ground make on site disposal impractical, up to one cubic foot of wastes may be stored in a leakproof container, in a dry locked place for up to 90 days.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of such materials is a violation of Federal Law.

Dispose of collars and other wastes contaminated by 1080 (carcasses, wool, hair, vegetation, soil, leather clothing, and water) under three feet of soil, at a safe location, preferably on property owned and managed by the applicator and at least one half mile from human habitations and water supplies.

Incineration may be used instead of burial for disposal in the field *(preferably on property owned or managed by the applicator)* at least 1/2 mile from human habitation and water supplies. Place collars and wastes *(listed above)* in an incinerator or refuse hole, saturate with diesel fuel, and ignite. Attend the burn until the contaminated material is completely consumed.

Alternatively, contact your state pesticide or Environmental Control Agency or the Hazardous Waste representative at the nearest EPA Regional Office for guidance in disposing of wastes at approved hazardous waste disposal facilities

CONTAINER DISPOSAL:

Metal Containers: Triple rinse contaminated and uncontaminated containers with water. Then puncture and dispose of contaminated containers and rinsate as above.
Plastic Containers: Triple rinse with water. Then puncture and dispose of container and rinsate as above.

COLLAR DISPOSAL: Dispose of punctured or unserviceable collars as above, except that not more than 10 collars may be buried in any one hole. If buried in trench, groups of 10 collars must be at least 10 feet apart.

56228-22

SEE BACK PANEL AND TECHNICAL BULLETIN FOR DIRECTIONS FOR USE.

6/91

ACCEPTED
SEP 30 1991

DIRECTIONS FOR USE

It is a violation of State and Federal Law to use this product in a manner inconsistent with its labeling or the Compound 1080 cancellation order. Misuse may result in civil or criminal enforcement action.

DO NOT REMOVE TOXICANT FROM COLLARS. DO NOT USE TORN, DAMAGED OR LEAKING COLLARS. Dispose of damaged collars in accordance with the "Storage and Disposal" instructions on this label.

Put collars on the necks of sheep or goats in fenced pastures where coyote predation is occurring or is expected to occur. Use collars only in accordance with the User Instructions and Use Restrictions contained in the accompanying Technical Bulletin.

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

May be fatal if swallowed. Wear waterproof gloves when handling 1080. Wash hands after handling 1080 or animals that have been contaminated with 1080 Do not use contaminated animals for food or feed.

ENVIRONMENTAL HAZARDS

This pesticide is very highly toxic to wildlife. Birds and mammals feeding on carcasses of contaminated livestock may be killed. Keep out of any body of water. Apply this product only as specified on this label.

ENDANGERED SPECIES CONSIDERATIONS

NOTICE: It is a Federal offense to use any pesticide in a manner that results in the death of a member of an endangered species.

NOTE TO PHYSICIAN

WARNING SYMPTOMS: 1080 poisoning results from the transformation of fluoroacetate into fluorocitrate within cell mitochondria. Poisoning is characterized by a symptom-free latent period of 1/2 to 2 hours or longer between ingestion and onset of symptoms (nausea, vomiting, diarrhea, and hyperactive behavior leading to convulsions, coma, and cyanosis). Ventricular fibrillation is commonly noted and is the primary cause of death Early symptoms include alteration of heart sounds and premature, weak contractions.

TREATMENT: No effective antidote is known but symptomatic treatment may be effective. Establish respiration, create artificial airway if necessary Check adequacy of tidal volume. Initiate emesis If patient is comatose, convulsing, or has lost the gag reflex, endotracheal intubation should precede gastric lavage with large bore tube. Administer activated charcoal and magnesium sulfate. Treat seizures with IV diazepam Monitor cardiac function closely. Treatment with glyceryl monoacetate (monoacetin) may be effective; however, it is experimental and unproven in humans. CONSULT NEAREST POISON CONTROL CENTER FOR CURRENT INFORMATION. Symptoms of non-lethal intoxication will usually subside within 12-24 hours.

COMPOUND 1080 (LPC)

Manufacturing-Use Product

For use only for reformulation into Sodium Fluoroacetate solutions for use only in Federally-Registered Livestock Protection collars

ACTIVE INGREDIENT:	
Sodium fluoroacetate	90.0%
INERT INGREDIENTS:	10.0%
TOTAL	100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

IF SWALLOWED: Induce vomiting at once with an emetic such as syrup of ipecac: use as directed. If emetic is not available, drink 1-2 glasses of water and induce vomiting by touching back of throat with finger. Do not induce vomiting or give anything by mouth to an unconscious person. PROMPT TREATMENT IS MANDATORY. GET MEDICAL ATTENTION IMMEDIATELY.

IF ON SKIN - Wash the exposed area twice with soap and water.

IF IN EYES - Wash eyes with plenty of water for at least 15 minutes

IF ON CLOTHING - Remove contaminated clothing and wash before re-use Dispose of all contaminated leather, including shoes, boots, and gloves, according to the pesticide Disposal Section See disposal instruction on side panel.

SEE LEFT SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est No. 5217-AL-1
EPA Reg No 56228-26

Net Weight. 8 ounces

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store Compound 1080 only in original container, in a dry, locked place away from food, feed, domestic animals and corrosive chemicals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of such materials is a violation of Federal Law.

Dispose of unsafe containers or other wastes contaminated by Compound 1080 under three feet of soil, at a safe location, at least one half mile from human habitations and water supplies.

Alternatively, contact your state pesticide or Environmental Control Agency or the Hazardous Waste representative at the nearest EPA Regional Office for guidance in disposing of wastes at approved hazardous waste disposal facilities.

CONTAINER DISPOSAL: Triple rinse contaminated and uncontaminated containers with water. Then puncture and dispose of contaminated containers and rinsate as above.

DIRECTIONS FOR USE

It is a violation of State and Federal Law to use this product in a manner inconsistent with its labeling or the Compound 1080 cancellation order. Misuse may result in civil or criminal enforcement action

This product may only be used to prepare Sodium Fluoroacetate solutions for injection into toxicant reservoirs of Federally-registered Livestock Protection Collars.

ACCEPTED
5/28/91
Under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, for the pesticide registered under EPA Reg. No. 56228-26

11/90

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Convulsive Poison! Poisonous if swallowed. Do not breathe dust. Do not contaminate feed and foodstuffs. Keep away from children, pets and domestic animals. Wash thoroughly with soap and water after handling and before eating or smoking. Clean clothing should be used daily.

ENVIRONMENTAL HAZARDS

This product is toxic to fish, birds, and other wildlife. Baits exposed on soil surface may be hazardous to birds and other wildlife. Do not apply directly to lakes, streams or ponds. Do not contaminate water by cleaning of equipment, or disposal of wastes.

DIRECTIONS FOR USE

Use this product only for formulating vertebrate pesticides. Formulators who use this product are responsible for providing data to support their registration. All strychnine baits formulated with this product for control of ground squirrels, or *microtus* must be dyed yellow or green.

STRYCHNINE ALKALOID N.F.X.

Powder (Technical)

FOR FORMULATING VERTEBRATE PESTICIDES ONLY

ACTIVE INGREDIENT:
Strychnine Alkaloid 98.4%
INERT INGREDIENTS: 1.6%
TOTAL 100.0%

NOT FOR REFORMULATION INTO END-USE PRODUCTS THAT ARE TO BE USED FOR FOOD OR FEED CROP USES

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

If less than ten (10) minutes have passed since the poison was taken, give 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Repeat until vomit fluid is clear. Have patient lie down in quiet, darkened room and keep him warm and quiet. Do not induce vomiting or give anything by mouth to an unconscious person.

IF INHALED - Remove victim to fresh air. Apply artificial respiration if indicated.

IF ON SKIN - Remove contaminated clothing and wash affected areas with soap and water.

IF IN EYES - Flush eyes with plenty of water. Get medical attention if irritation persists.

NOTE TO PHYSICIAN

A. Administer 100% OXYGEN by positive pressure to provide as much pulmonary gas exchange as possible, despite seizures.

B . Administer ANTICONVULSANT DRUGS intravenously to control convulsions.

CAUTION: It may be difficult or impossible to stop the seizure activity without stopping respiration. Be prepared to maintain pulmonary ventilation mechanically. Tracheotomy may be necessary if seizures are prolonged.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-16

Net Weight oz.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

NOTICE: The seller guarantees the ingredients as stated but makes no warranty of any kind on the life of the material. The user assumes all risks for use or handling if not used as specified.

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Convulsive Poison! Poisonous if swallowed. Do not breathe dust. Do not contaminate feed and foodstuffs. Keep away from children, pets and domestic animals. Wash thoroughly with soap and water after handling and before eating or smoking. Clean clothing should be used daily.

ENVIRONMENTAL HAZARDS

This product is toxic to fish, birds, and other wildlife. Baits exposed on soil surface may be hazardous to birds and other wildlife. Do not apply directly to lakes, streams or ponds. Do not contaminate water by cleaning of equipment, or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

NOTICE: The killing of an endangered species during strychnine baiting operations may result in a fine and/or imprisonment under the Endangered Species Act. Before baiting, the user is advised to contact the regional U.S. Fish and Wildlife Service (Endangered Species Specialist) or the local Fish and Game Office for specific information on endangered species. Strychnine baits should not be used in the geographic ranges of the following species except under programs and procedures approved by the USEPA: California Condor, San Joequin Kit Fox, Aleutian Canada Goose, Morro Bay Kangaroo Rat, Gray Wolf, Grizzly Bear, and Salt Marsh Harvest Mouse.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS

For use against pigeons in nonagricultural areas (in and around buildings). The use to control pigeons will be prohibited in the following areas for the protection of endangered species:

Species	Prohibited Areas
Yellow-shouldered blackbird	Puerto Rico
Puerto Rican plain pigeon	Puerto Rico
Peregrine falcon (pigeon control only)	Do not use within 5 miles of aeries or critical habitats. Do not use when migratory falcons may be present. Consult with local fish and game agencies or regional Fish and Wildlife Service.

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

PIGEON BAIT STRYCHNINE CORN

ACTIVE INGREDIENT:	
Strychnine Alkaloid	0.4%
INERT INGREDIENTS:	99.6%
TOTAL:	100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

If less than ten (10) minutes have passed since the poison was taken, give 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Repeat until vomit fluid is clear. Have patient lie down in quiet, darkened room and keep him warm and quiet. Do not induce vomiting or give anything by mouth to an unconscious person.

IF INHALED - Remove victim to fresh air. Apply artificial respiration if indicated.

IF ON SKIN - Remove contaminated clothing and wash affected areas with soap and water.

IF IN EYES - Flush eyes with plenty of water. Get medical attention if irritation persists.

NOTE TO PHYSICIAN

A. Administer 100% OXYGEN by positive pressure to provide as much pulmonary gas exchange as possible, despite seizures.

B. Administer ANTICONVULSANT DRUGS intravenously to control convulsions.

CAUTION: It may be difficult or impossible to stop the seizure activity without stopping respiration. Be prepared to maintain pulmonary ventilation mechanically. Tracheotomy may be necessary if seizures are prolonged.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-8

Net Weight lbs.

DIRECTIONS FOR USE (Cont.)

PREBAITING: Prebait for several days in areas close to buildings to minimize hazard to beneficial birds and other wildlife. Scatter 1 to 5 quarts of untreated whole kernel corn on bare ground, continuing until corn is readily consumed. Do not put out poisoned bait until the corn has been eaten or swept up. Do not use if nontarget birds or mammals are using the area. The amounts needed will be determined by the daily consumption of untreated bait.

BAITING: Distribute poisoned corn in same localities and manner as with the untreated bait. Pick up and dispose of uneaten pigeon bait after 3 days of exposure per site. Inspect each site for nontarget species hazard daily. Where untreated bait is not easily retrievable, place bait in trays or V-shaped troughs. Pick up and burn or bury all visible dead birds daily.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty bag by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

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PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Convulsive Poison! Poisonous if swallowed. Do not breathe dust. Do not contaminate feed and foodstuffs. Keep away from children, pets and domestic animals. Wash throughly with soap and water after handling and before eating or smoking. Clean clothing should be used daily.

ENVIRONMENTAL HAZARDS

This product is toxic to fish, birds, and other wildlife. Baits exposed on soil surface may be hazardous to birds and other wildlife. Do not apply directly to lakes, streams or ponds. Do not contaminate water by cleaning of equipment, or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

NOTICE: The killing of an endangered species during strychnine baiting operations may result in a fine and/or imprisonment under the Endangered Species Act. Before baiting, the user is advised to contact the regional U.S. Fish and Wildlife Service (Endangered Species Specialist) or the local Fish and Game Office for specific information on endangered species. Strychnine baits should not be used in the geographic ranges of the following species except under programs and procedures approved by the USEPA: California Condor, San Joaquin Kit Fox, Aleutian Canada Goose, Morro Bay Kangaroo Rat, Gray Wolf, Grizzly Bear, and Salt Marsh Harvest Mouse.

RESTRICTED USE PESTICIDE

For retail sale to and use only by certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

0.35% STRYCHNINE MILO

ACTIVE INGREDIENT:

Strychnine Alkaloid	0.35%
INERT INGREDIENTS:	99.65%
TOTAL :	100.00%

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

If less than ten (10) minutes have passed since the poison was taken, give 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Repeat until vomit fluid is clear. Have patient lie down in quiet, darkened room and keep him warm and quiet. Do not induce vomiting or give anything by mouth to an unconscious person.

IF INHALED - Remove victim to fresh air. Apply artificial respiration if indicated.

IF ON SKIN - Remove contaminated clothing and wash affected areas with soap and water.

IF IN EYES - Flush eyes with plenty of water. Get medical attention if irritation persists.

NOTE TO PHYSICIAN

A. Administer 100% OXYGEN by positive pressure to provide as much pulmonary gas exchange as possible, despite seizures.

B . Administer ANTICONVULSANT DRUGS intravenously to control convulsions.

CAUTION: It may be difficult or impossible to stop the seizure activity without stopping respiration. Be prepared to maintain pulmonary ventilation mechanically. Tracheotomy may be necessary if seizures are prolonged.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-11

Net Weight lbs.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. Sale, distribution and use of this product must be in accordance with the provisions of the final order on Strychnine by the Administrator of the U.S. Environmental Protection Agency.

USE RESTRICTIONS

For use to control kangaroo rats, cotton rats, pocket gophers, and jackrabbits. Do not use within 1 mile of the boundary of a prairie dog colony where the presence of a black-footed ferret is confirmed by the U.S. Fish and Wildlife Service Office of Endangered Species or a comparable State agency.

Do not expose baits in a manner which presents a likely hazard to pets, poultry, or livestock. Do not broadcast bait. Do not place bait in piles. Where feasible, pick up and burn or bury all visible carcasses of animals in or near treated areas.

See back panel for Directions for Use for individual species.

6/89

DIRECTIONS FOR USE
(0.35% Strychnine Milo)

KANGAROO RATS:

Ord's *(Dipodomys ordi)*, Merriam's *(D. merriami)*, Banner-tailed *(D. spectabilis)*, Texas Kangaroo Rat *(D. elator)*

USE RESTRICTIONS

For use against kangaroo rats in rangeland, and cropland. Do not use in non-agricultural areas. Do not use for kangaroo rat control in areas occupied by the Utah Prairie dog in Garfield, Iron, Kane, Piute, Sevier, and Wayne Counties, Utah. Do not use for kangaroo rat control in areas occupied by the masked bobwhite quail in Pima and Santa Cruz Counties, Arizona. Do not apply where the Morrow Bay kangaroo rat, *Dipodomys heermani morroensis*, is present in or near a 1.7 square mile area south of Morro Bay, San Luis Obispo County.

BAITING

Spot Baiting: Evenly scatter 3 to 4 tablespoons of bait on bare ground near active burrow rows. Kangaroo rats living within 30 yards of each baiting spot are likely to find the bait. Scatter grain as much as possible to prevent one or two animals from taking all the bait. Do not place in piles.

POCKET GOPHERS:

Plains Pocket Gopher *(Geomys bursarius)*, Yellow-faced Pocket Gopher *(Pappogeomys castanops)*, Northern Pocket Gopher *(Thomomys talpoides)*, Southern Pocket Gopher *(Thomomys umbrinus)*, Mazama Pocket Gopher *(Thomomys mazama)*, Mountain Pocket Gopher *(Thomomys monticola)*, Townsend's Pocket Gopher *(Thomomys townsendii)*, Botta Pocket Gopher *(Thomomys bottae)*, Camas Pocket Gopher *(Thomomys bulbivorous)*.

USE RESTRICTIONS

Apply only by use of a mechanical burrow builder.

BAITING

Burrow Builder Applications: Follow manufacturer's instructions for the equipment used to apply bait. Apply 1 to 2 pounds of bait per acre using 20- to 30-foot row-spacing intervals. Apply only when soil condition is proper to insure formation of a good artificial burrow.

COTTON RATS (Sigmodon hispidus)

USE RESTRICTIONS

For use against cotton rats in rangeland, pasture, and cropland. Do not use in non-agricultural areas. Do not use for cotton rat control in areas occupied by the Mississippi sandhill crane in Jackson County, Mississippi. Do not use for cotton rat control in areas occupied by the Cape Sable sparrow In Collier, Dade and Monroe Counties, Florida. Do not use for cotton rat control in habitats occupied by Attwater's greater prairie chicken in the following Texas counties: Aransas, Austin, Brazoria, Colorado, Fort Bend, Galveston, Goliad, Refugio, and Victoria.

BAITING

Spot Baiting: Lightly scatter teaspoon quantities of bait (about 80 baits per pound) in runways near active burrows.

JACKRABBITS:

White-tailed *(Lepus townsendii)*, Black-tailed *(Lepus californicus)*

USE RESTRICTIONS

For use against jackrabbits in rangeland, pasture, cropland and around airports. Do not use for jackrabbit control in areas occupied by the Utah prairie dog in Garfield, Iron, Kane, Piute, Sevier, and Wayne Countis, Utah. Do not use for jackrabbit control in areas occupied by the masked bobwhite quail in Pima and Santa Cruz Counties, Arizona. Do not use for jackrabbit control in habitats occupied by Attwater's greater prairie chicken in the following Texas counties: Aransas, Austin, Brazoria, Colorado, Fort Bend, Galveston, Goliad, Refugio, and Victoria.

PREBAITING

Before exposing poisoned bait, it is necessary to prebait (offer untreated bait) for 3-5 days to condition the rabbits to feed in locations other than where they are doing damage. Prebaiting is most effective when done in the late afternoon.

At a distance of about 100 yards from the field being damaged, place a small handful amount of untreated bait at intervals of 10-15 steps, preferably in trails.

BAITING

In the late afternoon, remove or cover all prebait and replace with a heaping tablespoon of poisoned bait at the same spot where prebait has been accepted.

Do not expose baits in a manner which presents a potential hazard to pets, poultry, or livestock. Pick up and burn all visible carcasses of animals found in or near treated areas.

6/89

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Convulsive Poison! Poisonous if swallowed. Do not broathe dust. Do not contaminate feed and food-stuffs. Keep away from children, pets and domestic animals. Wash throughly with soap and water after handling and before eating or smoking. Clean clothing should be used daily.

ENVIRONMENTAL HAZARDS

This product is toxic to fish, birds, and other wildlife. Baits exposed on soil surface may be hazardous to birds and other wildlife. Do not apply directly to lakes, streams or ponds. Do not contaminate water by cleaning of equipment, or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

NOTICE: The killing of an endangered species during strychnine baiting operations may result in a fine and/or imprisonment under the Endangered Species Act. Before baiting, the user is advised to contact the regional U.S. Fish and Wildlife Service (Endangered Species Specialist) or the local Fish and Game Office for specific information on endangered species. Strychnine baits should not be used in the geographic ranges of the following species except under programs and procedures approved by the USEPA: California Condor, San Joaquin Kit Fox, Aleutian Canada Goose, Morro Bay Kangaroo Rat, Gray Wolf, Grizzly Bear, and Salt Marsh Harvest Mouse.

RESTRICTED USE PESTICIDE

For retail salo to and use only by certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

0.5% STRYCHNINE S.R.O. FIELD RODENT BAIT

(Steam-rolled Oats)

ACTIVE INGREDIENT:

Strychnine Alkaloid	0.5%
INERT INGREDIENTS:	99.5%
TOTAL :	100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

If less than ten (10) minutes have passed since the poison was taken, give 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Repeat until vomit fluid is clear. Have patient lie down in quiet, darkened room and keep him warm and quiet. Do not induce vomiting or give anything by mouth to an unconscious person.

IF INHALED - Remove victim to fresh air. Apply artificial respiration if indicated.

IF ON SKIN - Remove contaminated clothing and wash affected areas with soap and water.

IF IN EYES - Flush eyes with plenty of water. Get medical attention if irritation persists.

NOTE TO PHYSICIAN

A. Administer 100% OXYGEN by positive pressure to provide as much pulmonary gas exchange as possible, despite seizures.

B . Administer ANTICONVULSANT DRUGS intravenously to control convulsions.

CAUTION: It may be difficult or impossible to stop the seizure activity without stopping respiration. Be prepared to maintain pulmonary ventilation mechanically. Tracheotomy may be necessary if seizures are prolonged.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-12

Net Weight lbs.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling. Sale, distribution and use of this product must be in accordance with the provisions of the final order on Strychnine by the Administrator of the U.S. Environmental Protection Agency.

USE RESTRICTIONS

For use to control ground squirrels, kangaroo rats, cotton rats, and pocket gophers. Do not use within 1 mile of the boundary of a prairie dog colony where the presence of a black-footed ferret is confirmed by the U.S. Fish and Wildlife Service Office of Endangered Species or a comparable State agency.

Do not expose baits in a manner which presents a likely hazard to pets, poultry, or livestock. Do not broadcast bait. Do not place bait in piles. Where feasible, pick up and burn or bury all visible carcasses of animals in or near treated areas.

See back panel for Directions for Use for individual species.

6/89

DIRECTIONS FOR USE
(0.5% Strychnine S.R.O. - Field Rodent Bait)

KANGAROO RATS:

Ord's (*Dipodomys ordi*), Merriami's (*D. merriami*), Banner-tailed (*D. spectabilis*), Texas Kangaroo Rat (*D. elator*)

USE RESTRICTIONS

For use ageinst kangaroo rats in rangelend, and cropland. Do not use in non-agricultural areas. Do not use for kangaroo rat control in areas occupied by the Utah Prairie dog in Garfield, Iron, Kane, Piute, Sevier, and Weyne Counties, Utah. Do not use for kangaroo rat control in areas occupied by the masked bobwhite quail in Pima and Santa Cruz Counties, Arizona. Do not apply where the Morrow Bay kangaroo rat, *Dipodomys heermani mooroensis*, is present in or near a 1.7 square mile eree south of Morro Bay, San Luis Obispo County

BAITING

Spot Baiting: Evenly scetter 3 to 4 tablespoons of bait on bare ground near active burrow rows. Kangaroo rats living within 30 yards of each baiting spot are likely to find the bait. Scatter grain as much es possible to prevent one or two animals from taking all the bait. Do not place in piles.

COTTON RATS (*Sigmodon hispidus*)

USE RESTRICTIONS

For use against cotton rats in rengeland, pasture, and cropland. Do not use in non-egricultural areas. Do not use for cotton ret control in arees occupied by the Mississippi sendhill crane in Jackson County, Mississippi. Do not use for cotton rat control in erees occupied by the Cepe Sable sparrow in Collier, Dade end Monroe Counties, Florida. Do not use for cotton rat control in habitats occupied by Attwater's greater prairie chicken in the following Texas counties: Aransas, Austin, Brazoria, Colorado, Fort Bend, Gelveston, Goliad, Refugio, and Victoria.

BAITING

Spot Baiting: Lightly scatter teaspoon quantities of bait (about 80 baits per pound) in runways near active burrows.

POCKET GOPHERS:

Plains Pocket Gopher (*Geomys bursarius*), Yellow-faced Pocket Gopher (*Pappogeomys castanops*), Northern Pocket Gopher (*Thomomys talpoides*), Southern Pocket Gopher (*Thomomys umbrinus*), Mazama Pocket Gopher (*Thomomys mazama*), Mountain Pocket Gopher (*Thomomys monticola*), Townsend's Pocket Gopher (*Thomomys townsendii*), Botta Pocket Gopher (*Thomomys bottae*), Camas Pocket Gopher (*Thomomys bulbivorous*).

USE RESTRICTIONS

Apply only by use of a mechanical burrow builder.

BAITING

<u>Burrow Builder Applications:</u> Follow manufacturer's instructions for the equipment used to apply bait. Apply 1 to 2 pounds of bait per acre using 20- to 30-foot row-spacing intervals. Apply only when soil condition is proper to insure formation of e good ertificial burrow.

GROUND SQUIRRELS:

Rock, Uinta, Townsend's, Golden-mantled, Franklin's, Richardson's, Thirteen-Lined, Columbian.

USE RESTRICTIONS

For use against ground squirrels in rangeland, pasture end cropland , and non-agricultural areas. Do not use for ground squirrel control within 200 yards of preirie dog colonies. Do not use within one mile of e preirie dog colony where the presence of a black-footed ferret has been confirmed within a five year period. Do not use for ground squirrel control in areas occupied by Utah prairie dogs in Garfield, Iron, Kane, Piute, Sevier, and Wayne Counties, Utah.

BAITING

Evenly scatter a tablespoon quantity of bait (about 60 baits per pound) on bare ground over 2 to 3 square fet at side or behind each active burrow. Do not overbait. Do not expose baits in a manner which presents a potential hazard to pets, poultry, or livestock. Do not place beit in piles. Pick up end burn or bury all visible carcasses of animals found in or near treated areas

6/89

0.35% STRYCHNINE MILO FOR HAND BAITING POCKET GOPHERS

ACTIVE INGREDIENT:
Strychnine Alkaloid 0.35%
INERT INGREDIENTS: 99.65%
TOTAL : 100.00%

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Convulsive Poison! Poisonous if swallowed. Do not breathe dust. Do not contaminate feed and food-stuffs. Keep away from children, pets and domestic animals. Wash thoroughly with soap and water after handling and before eating or smoking. Clean clothing should be used daily.

ENVIRONMENTAL HAZARDS

This product is toxic to fish, birds, and other wildlife. Baits exposed on soil surface may be hazardous to birds and other wildlife. Do not apply directly to lakes, streams or ponds. Do not contaminate water by cleaning of equipment, or disposal of wastes.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling .

USE RESTRICTIONS

For use against Plains Pocket Gopher *(Geomys bursarius)*, Yellow-faced Pocket Gopher *(Pappogeomys castanops)*, Northern Pocket Gopher *(Thomomys talpoides)*, Southern Pocket Gopher *(Thomomys umbrinus)*, Mazama Pocket Gopher *(Thomomys mazama)*, Mountain Pocket Gopher *(Thomomys monticola)*, Townsend's Pocket Gopher *(Thomomys townsendii)*, Botta Pocket Gopher *(Thomomys bottae)*, Camas Pocket Gopher *(Thomomys bulbivorous)*. Do not apply this product by use of a mechanical burrow builder. Do not apply this product at residential sites.

BAITING

Remove burrow plug from the flat side of the burrow fan. Use long handled spoon and insert 1 teaspoon of bait into main runway system. Close tunnel with soil. Do not permit soil to cover bait. Depending upon pocket gopher population levels, one pound of bait will treat one to eight acres when applied by hand.

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

If less than ten (10) minutes have passed since the poison was taken, give 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Repeat until vomit fluid is clear. Have patient lie down in quiet, darkened room and keep him warm and quiet. Do not induce vomiting or give anything by mouth to an unconscious person.

IF INHALED - Remove victim to fresh air. Apply artificial respiration if indicated.

IF ON SKIN - Remove contaminated clothing and wash affected areas with soap and water.

IF IN EYES - Flush eyes with plenty of water. Get medical attention if irritation persists.

NOTE TO PHYSICIAN

A. Administer 100% OXYGEN by positive pressure to provide as much pulmonary gas exchange as possible, despite seizures.

B . Administer ANTICONVULSANT DRUGS intravenously to control convulsions.

CAUTION: It may be difficult or impossible to stop the seizure activity without stopping respiration. Be prepared to maintain pulmonary ventilation mechanically. Tracheotomy may be necessary if seizures are prolonged.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-19

Net Weight lbs.

6/89

0.5% STRYCHNINE S.R.O. FOR HAND BAITING POCKET GOPHERS

(Steam-rolled Oats)

ACTIVE INGREDIENT:	
Strychnine Alkaloid	0.5%
INERT INGREDIENTS:	99.5%
TOTAL :	100.0%

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Convulsive Poison! Poisonous if swallowed. Do not breathe dust. Do not contaminate feed and food-stuffs. Keep away from children, pets and domestic animals. Wash thoroughly with soap and water after handling and before eating or smoking. Clean clothing should be used daily.

ENVIRONMENTAL HAZARDS

This product is toxic to fish, birds, and other wildlife. Baits exposed on soil surface may be hazardous to birds and other wildlife. Do not apply directly to lakes, streams or ponds. Do not contaminate water by cleaning of equipment, or disposal of wastes.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling .

USE RESTRICTIONS

For use against Plains Pocket Gopher *(Geomys bursarius)*, Yellow-faced Pocket Gopher *(Pappogeomys castanops)*, Northern Pocket Gopher *(Thomomys talpoides)*, Southern Pocket Gopher *(Thomomys umbrinus)*, Mazama Pocket Gopher *(Thomomys mazama)*, Mountain Pocket Gopher *(Thomomys monticola)*, Townsend's Pocket Gopher *(Thomomys townsendii)*, Botta Pocket Gopher *(Thomomys bottae)*, Camas Pocket Gopher *(Thomomys bulbivorous)*. Do not apply this product by use of a mechanical burrow builder. Do not apply this product at residential sites.

BAITING

Remove burrow plug from the flat side of the burrow fan. Use long handled spoon and insert 1 teaspoon of bait into main runway system. Close tunnel with soil. Do not permit soil to cover bait. Depending upon pocket gopher population levels, one pound of bait will treat one to eight acres when applied by hand.

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

If less than ten (10) minutes have passed since the poison was taken, give 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Repeat until vomit fluid is clear. Have patient lie down in quiet, darkened room and keep him warm and quiet. Do not induce vomiting or give anything by mouth to an unconscious person.

IF INHALED - Remove victim to fresh air. Apply artificial respiration if indicated.

IF ON SKIN - Remove contaminated clothing and wash affected areas with soap and water.

IF IN EYES - Flush eyes with plenty of water. Get medical attention if irritation persists.

NOTE TO PHYSICIAN

A. Administer 100% OXYGEN by positive pressure to provide as much pulmonary gas exchange as possible, despite seizures.

B. Administer ANTICONVULSANT DRUGS intravenously to control convulsions.

CAUTION: It may be difficult or impossible to stop the seizure activity without stopping respiration. Be prepared to maintain pulmonary ventilation mechanically. Tracheotomy may be necessary if seizures are prolonged.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-20

Net Weight lbs.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

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PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Convulsive Poison! Poisonous if swallowed. Do not breathe dust. Do not contaminate feed and food-stuffs. Keep away from children, pets and domestic animals. Wash thoroughly with soap and water after handling and before eating or smoking. Clean clothing should be used daily.

ENVIRONMENTAL HAZARDS

This product is toxic to fish, birds, and other wildlife. Baits exposed on soil surface may be hazardous to birds and other wildlife. Do not apply directly to lakes, streams or ponds. Do not contaminate water by cleaning of equipment, or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

NOTICE: The killing of an endangered species during strychnine baiting operations may result in a fine and/or imprisonment under the Endangered Species Act. Before baiting, the user is advised to contact the regional U.S. Fish and Wildlife Service (Endangered Species Specialist) or the local Fish and Game Office for specific information on endangered species. Strychnine baits should not be used in the geographic ranges of the following species except under programs and procedures approved by the USEPA: California Condor, San Joaquin Kit Fox, Aleutian Canada Goose, Morro Bay Kangaroo Rat, Gray Wolf, Grizzly Bear, and Salt Marsh Harvest Mouse.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS

Use is prohibited in areas known to be occupied by the gray wolf or grizzly bear.

BAITING

For use against porcupines in non-agricultural areas. Nail block containing strychnine-salt mixture to trunk of trees about 8 inches above one of the larger branches and 10 feet or more above the snowline.

RESTRICTED USE PESTICIDE

For retail sale to and use only by certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

PORCUPINE BLOCK STRYCHNINE-SALT MIXTURE

ACTIVE INGREDIENT:	
Strychnine Alkaloid	5.79%
INERT INGREDIENTS:	94.21%
TOTAL :	100.00%

KEEP OUT OF REACH OF CHILDREN
DANGER - POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

If less than ten (10) minutes have passed since the poison was taken, give 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Repeat until vomit fluid is clear. Have patient lie down in quiet, darkened room and keep him warm and quiet. Do not induce vomiting or give anything by mouth to an unconscious person.

IF INHALED - Remove victim to fresh air. Apply artificial respiration if indicated.

IF ON SKIN - Remove contaminated clothing and wash affected areas with soap and water.

IF IN EYES - Flush eyes with plenty of water. Get medical attention if irritation persists.

NOTE TO PHYSICIAN

A. Administer 100% OXYGEN by positive pressure to provide as much pulmonary gas exchange as possible, despite seizures.

B. Administer ANTICONVULSANT DRUGS intravenously to control convulsions.

CAUTION: It may be difficult or impossible to stop the seizure activity without stopping respiration. Be prepared to maintain pulmonary ventilation mechanically. Tracheotomy may be necessary if seizures are prolonged.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-4

Net Weight Contents 2 25 oz.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Convulsive Poison! Poisonous if swallowed. Do not breathe dust. Do not contaminate feed and foodstuffs. Keep away from children, pets, and domestic animals. Wash thoroughly with soap and water after handling and before eating or smoking. Clean clothing should be used daily.

ENVIRONMENTAL HAZARDS

This product is toxic to fish, birds, and other wildlife. Baits exposed on soil surface may be hazardous to birds and other wildlife. Do not apply directly to lakes, streams or ponds. Do not contaminate water by cleaning of equipment, or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

NOTICE: The killing of an endangered species during strychnine baiting operations may result in a fine and/or imprisonment under the Endangered Species Act. Before baiting, the user is advised to contact the Regional U.S. Fish and Wildlife Service (Endangered Species Specialist) or the local Fish and Game Office for specific information on endangered species. Strychnine baits should not be used in the geographic ranges of the following species except under programs and procedures approved by the USEPA: California Condor, San Joaquin Kit Fox, Aleutian Canada Goose, Morro Bay Kangaroo Rat, Gray Wolf, Grizzly Bear, and Salt Marsh Harvest Mouse, Utah Prairie Dog and Masked Bob White Quail.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ ENTIRE LABEL. USE STRICTLY IN ACCORDANCE WITH PRECAUTIONARY STATEMENTS AND DIRECTIONS AND WITH APPLICABLE STATE AND FEDERAL REGULATIONS

DIRECTIONS FOR USE are continued at the top of the right panel.

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

FOR DISTRIBUTION AND USE ONLY WITHIN ARIZONA, IDAHO, NEVADA, NEW MEXICO, AND UTAH

1.6% STRYCHNINE PASTE

ACTIVE INGREDIENT:	
Strychnine Alkaloid	1.6%
INERT INGREDIENTS:	98.4%
TOTAL :	100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

If less than ten (10) minutes have passed since the poison was taken, give 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Repeat until vomit fluid is clear. Have patient lie down in quiet, darkened room and keep him warm and quiet. Do not induce vomiting or give anything by mouth to an unconscious person.

IF INHALED - Remove victim to fresh air. Apply artificial respiration if indicated.

IF ON SKIN - Remove contaminated clothing and wash affected areas with soap and water.

IF IN EYES - Flush eyes with plenty of water. Get medical attention if irritation persists.

NOTE TO PHYSICIAN

A. Administer 100% OXYGEN by positive pressure to provide as much pulmonary gas exchange as possible, despite seizures.

B. Administer ANTICONVULSANT DRUGS intravenously to control convulsions.

CAUTION: It may be difficult or impossible to stop the seizure activity without stopping respiration. Be prepared to maintain pulmonary ventilation mechanically. Tracheotomy may be necessary if seizures are prolonged.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
Animal Damage Control
Hyattsville, MD 20782
EPA Est. No. 56228-ID-01
EPA Reg. No. 56228-27

Net Contents: 1 Gallon

DIRECTIONS FOR USE *(Cont.)*

USE RESTRICTIONS

For use against the following rabbit and hare species in rangelands, pasture, and non-agricultural areas (around airports only):

Desert cottontail rabbits *(Sylvilagus audobonii)*
Eastern cottontail rabbits *(S. floridanus)*
Black-tailed jackrabbits *(Lepus californicus)*
White-tailed jackrabbits *(L. towndsendii)*
Antelope jackrabbits *(L. alleni)*

Do not use in areas occupied by the Utah Prairie Dog in Garfield, Iron, Kane, Piute, Sevier, and Wayne counties, Utah. Do not use in areas occupied by the Masked Bobwhite Quail in Pima and Santa Cruz counties, Arizona. Do not apply strychnine baits on or above food or feed crops.

Do not apply this bait intentionally to kill any species not claimed on this label.

See back panel for remainder of DIRECTIONS FOR USE including directions for prebaiting, mixing bait, and bait application.

STORAGE AND DISPOSAL

PROHIBITION: Do not contaminate water, food or feed by storage, disposal or cleaning of equipment.

STORAGE. Keep pesticide in original container. Do not put concentrate or dilute into food or drink containers.
Keep cool in shade, out of direct sunlight.
Not for use or store in or around the home.
Do not store next to feed or transport in or on vehicles containing foodstuffs or feeds.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled paste, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact the appropriate State agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Pesticide, paste, or rinsate that cannot be used or chemically reprocessed should be disposed of in accordance with the regulations of the appropriate State agency. Pick up and burn or bury any uneaten bait and dead animals daily.

CONTAINER DISPOSAL: Triple rinse (or equivalent) offer for recycling or reconditioning, or dispose of in approved landfill and in accordance with the regulations of the appropriate State Agency.

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DIRECTIONS FOR USE *(Cont.)*

MIXING DIRECTIONS:
SHAKE STRYCHNINE PASTE WELL BEFORE USE
REFRIGERATE STRYCHNINE PASTE UNTIL USED

CARROTS: Cut carrots into 1/4 to 1/2 inch cubes or slices. Use untreated carrot cubes or slices for prebait. To prepare toxic bait, place 25 pounds of carrot cubes or slices into a tub. Heat a ONE GALLON can of Strychnine Paste until lukewarm. Shake well and sprinkle the warmed contents of the ONE GALLON container over the 25 pounds of bait material in the tub. Stir until carrots are evenly coated.

ALFALFA OR CLOVER TIPS: Use untreated tips for prebait. To prepare toxic bait, place 25 pounds of tips into a tub. Heat a ONE GALLON can of Strychnine Paste until lukewarm. Shake well and sprinkle the warmed contents of the ONE GALLON container over the 25 pounds of bait material in the tub. Stir until tips are evenly coated.

DRY ALFALFA OR CLOVER TIPS: Use untreated dry tips for prebait. To prepare toxic bait, place 16 pounds of tips into a tub. Heat a ONE GALLON can of Strychnine Paste until lukewarm. Shake well and sprinkle the warmed contents of the ONE GALLON container over the 16 pounds of bait material in the tub. Stir until tips are evenly coated.

PREBAITING DIRECTIONS:
Before exposing poisoned bait, prebait with untreated bait for 3 to 5 days to condition animals to feed in locations other than where they are doing damage. Prebait with the same plant material that you intend to use in toxic baits. Prebaiting is most effective when done in the late afternoon.

Place prebaits at 15-foot intervals adjacent to pasture, range area, or airport area where target animals are causing problems.

Place prebait along trails used by target rabbits or jackrabbits if such trails are evident.

CARROTS: Use 6 to 8 cubes or slices per bait placement.

ALFALFA OR CLOVER BAITS: Use one cup of bait per placement.

BAITING DIRECTIONS:
In the late afternoon, remove or cover all prebait and replace with equal amounts of poisoned bait made from the same plant material. Place bait in same locations as were used for prebait.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Keep away from humans, domestic animals, and pets. May be fatal or harmful if swallowed. Avoid eye or skin contact. Do not breathe dust. Avoid contamination of feed or food stuffs. Prevent the contact of bait with acids. Wash hands thoroughly with soap and water after use.

ENVIRONMENTAL HAZARDS

This product is toxic to wildlife and fish. Birds and other wildlife feeding in treated areas may be killed. Use with care when applying in areas frequented by wildlife or adjacent to any body of water. Keep out of lakes, ponds, or streams. This product shall not be applied over bodies of water, in areas inhabited by livestock, or where a hazard exists to rare or endangered species. Do not contaminate water by cleaning of equipment or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

Whooping Crane *(Grus americana)*
Do not use this product 30 days prior to arrival and 30 days after the whooping crane leaves its known critical habitat.

Attwater's Greater Prairie Chicken *(Tympanuchus cupido attwateri)*
Do not use this product in critical habitat of the Attwater's greater prairie chicken in the following Texas counties: Aransas, Austin, Brazoria, Colorado, De Witt, Ft. Bend, Galveston, Goliad, Harris, Refugio, Victoria, Waller, and Wharton.

Yellow-Shouldered Blackbird *(Agelaius xanthomus) and* **Puerto Rican Plain Pigeon** *(Columba inornata wetmorei)*
Do not use in critical habitat except in tamper-proof bait boxes: within 6.3 miles of central Aquirre Lago Cicra, Ceiba, San German; 9.4 miles of La Esperanza, south of highway 2 from city at Mayaquez to the city of Ponce, and all of Mona Island, Puerto Rico.

Utah Prairie Dog (Cynomys parvidens)
Do not use this product in critical habitat of the Utah prairie dog. (Utah)

Salt Marsh Harvest Mouse *(Reithrodontomys raviventris)*
Do not use this product in critical habitat within 0.5 mile of salt marsh vegetation and/or brackish water wetlands which are located 1) near or adjacent to San Pablo Bay and San Francisco Bay, or 2) in the Sacramento River below or adjacent to the confluence of the Sacramento River and the San Joaquin River. (California)

Morro Bay Kangaroo Rat *(Dipodomys heermanni morroensis)*
Do not use this product in critical habitat within 2.5 miles of Baywood Park which is located on Morro Bay. (California)

Aleutian Canada Goose *(Branta canadensis leucoparela)*
Do not use this product from October to March in the federally closed goose hunting areas in the State of California. See current duck and goose hunting game laws for current map.

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

ZINC PHOSPHIDE CONCENTRATE

FOR MOUSE CONTROL

For the control of meadow and pine voles, and white-footed mice in orchards and groves.

ACTIVE INGREDIENT:	
Zinc Phosphide	63.2%
INACTIVE INGREDIENTS:	36.8%
TOTAL	100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

Any person applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness, should be seen by a physician immediately.

If swallowed, drink 1-2 glasses of water and induce vomiting by touching the back of the throat with the finger. Avoid the use of all oils. Have person lie down and keep warm. Do not induce vomiting or give anything by mouth to an unconscious person.

If on skin or eyes, flush with plenty of water.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
NATIONAL TECHNICAL SUPPORT STAFF/ADC
Hyattsville, MD 20782
EPA Est No. 56228-ID-1
EPA Reg. No. 56228-6

Net Weight oz

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS: For control of meadow and pine voles (*Microtus spp.*) and white-footed mice (*Peromyscus spp.*) in orchards and groves. Apply bait after harvest while the orchard or grove is in a nonbearing phase. Do not apply on bare ground or growing crops. Wear rubber gloves when handling bait. Do not graze animals in treated areas.

MIXING: Use concentrates for making baits in open areas, especially if the baiting material is wet. Do not breathe any dry bait, use respiratory protection when mixing baits. Due to compaction of contents, can should be shaken before opening. Gradually mix one level teaspoon with 1 quart cubed apples (1/2" cubes). Bait material resembling human food must be altered in form by crushing, balling, dicing, or pelleting so that it is not readily recognizable food. Keep products away from children during bait preparation, storage, and transport.

Keep products away from irresponsible individuals, domestic animals, pets, and poultry.

BAITING: Place 1 or 2 cubes at frequent intervals in active trails under the cover of grass near the base of infested trees. Do not place the bait on bare ground. Do not retreat the same area with zinc phosphide at less than 30-day intervals. Do not exceed application rates specified on label.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Keep away from humans, domestic animals, and pets. May be fatal or harmful if swallowed. Avoid eye or skin contact. Do not breathe dust. Avoid contamination of feed or food stuffs. Prevent the contact of bait with acids. Wash hands thoroughly with soap and water after use.

ENVIRONMENTAL HAZARDS

This product is toxic to wildlife and fish. Birds and other wildlife feeding in treated areas may be killed. Use with care when applying in areas frequented by wildlife or adjacent to any body of water. Keep out of lakes, ponds, or streams. This product shall not be applied over bodies of water, in areas inhabited by livestock, or where a hazard exists to rare or endangered species. Do not contaminate water by cleaning of equipment or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

Whooping Crane *(Grus americana)*
Do not use this product 30 days prior to arrival and 30 days after the whooping crane leaves its known critical habitat.

Attwater's Greater Prairie Chicken *(Tympanuchus cupido attwateri)*
Do not use this product in critical habitat of the Attwater's greater prairie chicken in the following Texas counties: Aransas, Austin, Brazoria, Colorado, De Witt, Ft. Bend, Galveston, Goliad, Harris, Refugio, Victoria, Waller, and Wharton.

Yellow-Shouldered Blackbird *(Agelaius xanthomus) and* **Puerto Rican Plain Pigeon** *(Columba inornata wetmorei)*
Do not use in critical habitat except in tamper-proof bait boxes: within 6.3 miles of central Aquirre Lago Cicra, Ceiba, San German; 9.4 miles of La Esperanza; south of highway 2 from city at Mayaquez to the city of Ponce, and all of Mona Island, Puerto Rico.

Utah Prairie Dog (Cynomys parvidens)
Do not use this product in critical habitat of the Utah prairie dog. (Utah)

Salt Marsh Harvest Mouse *(Reithrodontomys raviventris)*
Do not use this product in critical habitat within 0.5 mile of salt marsh vegetation and/or brackish water wetlands which are located: 1) near or adjacent to San Pablo Bay and San Francisco Bay, or 2) in the Sacramento River below or adjacent to the confluence of the Sacramento River and the San Joaquin River. (California)

Morro Bay Kangaroo Rat *(Dipodomys heermanni morroensis)*
Do not use this product in critical habitat within 2.5 miles of Baywood Park which is located on Morro Bay. (California)

Aleutian Canada Goose *(Branta canadensis leucopareia)*
Do not use this product from October to March in the federally closed goose hunting areas in the State of California. See current duck and goose hunting game laws for current map.

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

ZINC PHOSPHIDE CONCENTRATE

FOR RAT CONTROL

For the control of Norway rats and black rats in rat burrows and in and around homes, industrial, commercial, agricultural, and public buildings..

ACTIVE INGREDIENT:	
Zinc Phosphide	63.2%
INACTIVE INGREDIENTS:	36.8%
TOTAL	100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER-POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

Any person applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness, should be seen by a physician immediately.

If swallowed, drink 1-2 glasses of water and induce vomiting by touching the back of the throat with the finger. Avoid the use of all oils. Have person lie down and keep warm. Do not induce vomiting or give anything by mouth to an unconscious person.

If on skin or eyes, flush with plenty of water.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
NATIONAL TECHNICAL SUPPORT STAFF/ADC
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-7

Net Weight oz.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS: For control of Norway rats *(Rattus norvegicus)* and roof rats *(R rattus)* in rat burrows and other infested areas in and around homes, industrial, commercial, agricultural, and public buildings. Do not expose poison bait in areas accessible to livestock and non-target wildlife.Wear an approved respirator and rubber gloves. Apply in a well ventilated area.

MIXING: Use concentrates for making baits in open areas, especially if the baiting material is wet. Do not breathe any dry bait; use respiratory protection when mixing baits.

Due to compaction of contents, can should be shaken before opening. Mix entire contents of can (1 oz.) with 4 pounds of fresh meat, such as ground beef, canned dog or cat food, fish, or poultry mash. Mix bait thoroughly.

Bait material resembling human food must be altered in form by crushing, balling, dicing, or pelleting so that it is not readily recognizable as food.

BAITING: Place rounded teaspoons of bait in piles at 8-10 foot intervals where rats feed, water, and travel. Place baits in tamper-proof bait boxes or in locations not accessible to children, pets, or domestic animals, and nontarget wildlife, or use tamper-resistant bait stations for products used in/around buildings.

Meat and fish baits must be placed in tamper-resistant bait stations or deeply into rat burrows because dogs and cats will actively search them out. Collect and properly dispose of uneaten bait and dead rodents after completion of the control program, often set at 72 hours. If baited areas are accessible to dogs, cats, or carnivorous or omnivorous non-target wildlife larger than Norway rats, bait stations must be of a design and strength which denies these animals access to bait. Secure and immobilize bait stations if necessary to deny these non-target animals access to bait.

Keep products away from children, irresponsible individuals, domestic animals, pets, and poultry.

Do not retreat the same area with zinc phosphide at less than 30-day intervals. Do not exceed application rates specified on label.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Keep away from humans, domestic animals, and pets. May be fatal or harmful if swallowed. Avoid eye or skin contact. Do not breathe dust. Avoid contamination of feed or food stuffs. Prevent the contact of bait with acids. Wash hands thoroughly with soap and water after use.

Use concentrations for making baits in open areas, especially if the baiting material is wet. Do not breathe any dry bait. use respiratory protection when mixing baits.

Keep products away from children, irresponsible individuals, domestic animals, pets, and poultry.

Place baits in locations not accessible to children, pets, livestock, and nontarget wildlife, or use tamper-resistant bait stations for products used in/around buildings.

ENVIRONMENTAL HAZARDS

This product is toxic to wildlife and fish. Birds and other wildlife feeding in treated areas may be killed. Use with care when applying in areas frequented by wildlife or adjacent to any body of water. Keep out of lakes, ponds, or streams. This product shall not be applied over bodies of water in areas inhabited by livestock or where a hazard exists to rare or endangered species. Do not contaminate water by cleaning of equipment or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

Whooping Crane *(Grus americana)*
Do not use this product 30 days prior to arrival and 30 days after the whooping crane leaves its known critical habitat.

Attwater's Greater Prairie Chicken *(Tympanuchus cupido attwateri)*
Do not use this product in critical habitat of the Attwater's greater prairie chicken in the following Texas counties: Aransas, Austin, Brazoria, Colorado, De Witt, Ft. Beno, Galveston, Goliad, Harris, Refugio, Victoria, Waller and Wharton.

Yellow-Shouldered Blackbird *(Agelaius xanthomus)* and **Puerto Rican Plain Pigeon** *(Columba inornata wetmorei)*
Do not use in critical habitat except in tamper-proof bait boxes within 6.3 miles of central Aquirre, Lago Cicra, Ceiba, San German, 9.4 miles of La Esperanza south of highway 2 from city at Mayaquez to the city of Ponce, and all of Mona Island, Puerto Rico.

Utah Prairie Dog (Cynomys parvidens)
Do not use this product in critical habitat of the Utah prairie dog (Utah).

See back panel for additional Endangered Species Considerations.

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

ZINC PHOSPHIDE CONCENTRATE

FOR MUSKRAT AND NUTRIA CONTROL

For the control of muskrats and nutria on floating rafts and around active burrows.

ACTIVE INGREDIENT:	
Zinc Phosphide	63.2%
INACTIVE INGREDIENTS:	36.8%
TOTAL	100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER—POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

Any person applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness should be seen by a physician immediately.

If swallowed, drink 1-2 glasses of water and induce vomiting by touching the back of the throat with the finger. Avoid the use of all oils. Have person lie down and keep warm. Do not induce vomiting or give anything by mouth to an unconscious person.

If on skin or eyes, flush with plenty of water.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
NATIONAL TECHNICAL SUPPORT STAFF/ADC
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-9

Net Weight   oz.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS: For control of muskrats *(Ondatra zibethicus)* and nutria *(Myocaster coypus)* where non-target species will not be endangered. Donot expose poison bait in areas accessible to livestock and non-target wildlife.

PREBAITING: Prepare prebait by cutting apples into eights, carrots or sweet potatoes into 2-inch pieces and coating them with corn oil.

Prebait may be placed on anchored floating large (4 x 4 feet) or small (6 x 6 inch) rafts in streams, canals, bayous or lakes adjacent to sugarcane or rice fields or floating structures (docks, etc.) where damage by muskrats or nutria is evident. On large waterways, large rafts may be spaced 1/4 to 1/2 miles apart; on small waterways, small rafts may be spaced 50 to 100 feet apart. Rafts may also be placed adjacent to areas where muskrats and nutria are active, e.g. slides, runs, burrows, or feeding areas. Place 10 pounds of prebait on large rafts and 4 pieces of prebait on small rafts, measure consumption daily. Prebait may also be placed on the ground adjacent to areas of rodent activity. Place 2-5 pieces of prebait at each location and measure consumption daily.

See back panel for additional Directions For Use.

ENDANGERED SPECIES CONSIDERATIONS
(Continued)

Salt Marsh Harvest Mouse *(Reithrodontomys raviventris)*
Do not use this product in critical habitat within 0 5 mile of salt marsh vegetation and/or brackish water wetlands which are located 1) near or adjacent to San Pablo Bay and San Francisco Bay, or 2) in the Sacramento River below or adjacent to the confluence of the Sacramento River and the San Joaquin River (California)

Morro Bay Kangaroo Rat *(Dipodomys heermanni morroensis)*
Do not use this product in critical habitat within 2 5 miles of Baywood Park which is located on Morro Bay.(California)

Aleutian Canada Goose *(Branta canadensis leucopareia)*
Do not use this product from October to March in the federally closed goose hunting areas in the State of California See current duck and goose hunting game laws for current map

DIRECTIONS FOR USE
(Continued)

MIXING BAIT: Wear an approved respirator and rubber gloves. Apply in a well ventilated area Due to compaction, can should be shaken before opening To mix bait, place 10 pounds of apples cut into eights, carrots, or sweet potatoes cut into 2 inch pieces in a 5 gallon container. Coat bait with 30 ml (1 oz) of corn oil Apply 48 grams (7 1/2 level tablespoons) of this product. Mix bait thoroughly by hand or mechanical mixer (When using apples, corn oil is not needed)

Bait material resembling human food must be altered in form by crushing, balling, dicing, or pelleting so that they are not readily recognizable as food

BAITING: Apply bait in locations where prebait was accepted

(Large Rafts) If all, or most of the 10 pounds of prebait has been eaten by the second night of prebaiting then bait by applying 10 pounds of zinc phosphide-treated bait. If 1/2 to 3/4 of the prebait has been eaten by the second night of prebaiting use 5 pounds of zinc phosphide-treated bait If only a few pieces have been eaten by the second night, move the raft to another location.If all, or almost all of the zinc phosphide-treated bait has been eaten the first night, 10 pounds of zinc phosphide-treated bait should be put out on the second night. If less than 2 5 pounds has been eaten the first night, 5 pounds should be put out on the second night.

(Small Rafts) If prebaits are eaten, four pieces of zinc phosphide-treated bait should be put out each night until no more bait is taken

(Ground) If prebaits are eaten, four pieces of zinc phosphide-treated bait should be put out each night until no more bait is taken.

Do not retreat the same area with zinc phosphide-treated bait at less then 30-day intervals

Collect and properly dispose of uneaten bait and dead rodents after completion of the control program, often set at 72 hours.

Do not exceed application rates specified on label.

EPA Reg. No. 56228-9

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Keep away from humans, domestic animals and pets. May be fatal or harmful if swallowed. Avoid eye or skin contact. Do not breathe dust. Avoid contamination of feed or food stuffs. Prevent the contact of bait with acids. Wash hands thoroughly with soap and water after use. Use rubber gloves if contact with skin may occur when mixing or placing baits. Wash all utensils, spoons, or measuring devices thoroughly.

ENVIRONMENTAL HAZARDS

This product is toxic to wildlife and fish. Birds and other wildlife feeding in treated areas may be killed. Use with care when applying in areas frequented by wildlife or adjacent to any body of water. Keep out of lakes, ponds, or streams. This product shall not be applied over bodies of water, in areas inhabited by livestock, or where a hazard exists to rare or endangered species. Do not contaminate water by cleaning of equipment or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

Whooping Crane *(Grus americana)*
Do not use this product 30 days prior to arrival and 30 days after the whooping crane leaves its known critical habitat.

Attwater's Greater Prairie Chicken *(Tympanuchus cupido attwateri)*
Do not use this product in critical habitat of the Attwater's greater prairie chicken in the following Texas counties: Aransas, Austin, Brazoria, Colorado, De Witt, Ft. Bend, Galveston, Goliad, Harris, Refugio, Victoria, Waller, and Wharton.

Yellow-Shouldered Blackbird *(Agelaius xanthomus)* and **Puerto Rican Plain Pigeon** *(Columba inornata wetmorei)*
Do not use in critical habitat except in tamper-proof bait boxes within 6.3 miles of central Aquirre Lago Cicra, Ceiba, San German; 9.4 miles of La Esperanza, south of highway 2 from city at Mayaquez to the city of Ponce, and all of Mona Island, Puerto Rico.

Utah Prairie Dog (Cynomys parvidens)
Do not use this product in critical habitat of the Utah prairie dog. (Utah)

Salt Marsh Harvest Mouse *(Reithrodontomys raviventris)*
Do not use this product in critical habitat within 0.5 mile of salt marsh vegetation and/or brackish water wetlands which are located: 1) near or adjacent to San Pablo Bay and San Francisco Bay, or 2) in the Sacramento River below or adjacent to the confluence of the Sacramento River and the San Joaquin River. (California)

Morro Bay Kangaroo Rat *(Dipodomys heermanni morroensis)*
Do not use this product in critical habitat within 2.5 miles of Baywood Park which is located on Morro Bay. (California)

Aleutian Canada Goose *(Branta canadensis leucopareia)*
Do not use this product from October to March in the federally closed goose hunting areas in the State of California. See current duck and goose hunting game laws for current map.

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

ZINC PHOSPHIDE ON WHEAT

FOR MOUSE CONTROL

For the control of meadow voles, prairie voles, pine voles, mountain voles, and white-footed mice in ornamentals, orchards, vineyards, rangelands, forests, lawns, golf courses, parks, nurseries, and highway medians.

ACTIVE INGREDIENT:	
Zinc Phosphide	1.82%
INACTIVE INGREDIENTS:	98.18%
TOTAL	100.00%

KEEP OUT OF REACH OF CHILDREN

CAUTION

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

Any person applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness, should be seen by a physician immediately.

If swallowed, drink 1-2 glasses of water and induce vomiting by touching the back of the throat with the finger. Avoid the use of all oils. Have person lie down and keep warm. Do not induce vomiting or give anything by mouth to an unconscious person.

If on skin or eyes, flush with plenty of water.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
NATIONAL TECHNICAL SUPPORT STAFF/ADC
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-3

Net Weight lbs.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. Do not apply bait on roads, over water, or where plants are grown for food or feed. Wear rubber gloves when handling bait. Due to compaction, can should be shaken before opening.

ORCHARDS,GROVES,NURSERIES,VINEYARDS, ORNAMENTALS, AND NONBEARING FRUIT TREES

USE RESTRICTIONS: For control of meadow, prairie, and pine voles *(Microtus spp.)* and white-footed mice *(Peromyscus spp.)* in orchards, groves, nurseries, vineyards, ornamentals, and nonbearing fruit trees. In orchards and vineyards, apply bait after harvest while in a nonbearing phase.

HAND BAITING: Near the base of each infested tree, place teaspoonful quantities of bait at 2-4 locations, either on surface or at the mouth of holes leading to underground burrow systems. Cover bait artificially (e.g., mats, boards) or by pulling overhanging grass back into place. Do not disturb the runway system. Bait at the rate of 3-5 pounds per acre of infested trees.

TRAILBUILDER: Drop teaspoonful quantities of bait at 4-5 foot intervals in the artificial trail made by the machine just inside the drip line on both sides of the trees. Apply at the rate of 2-3 pounds per acre.

BROADCAST BAITING: Under infested trees broadcast evenly by cyclone seeder or by hand. Concentrate in areas with the heaviest vegetative cover. Apply at the rate of 6-10 pounds per acre.

AERIAL APPLICATION: Broadcast bait at a rate of 6-10 pounds per acre. Bait applications should be made immediately after harvest and before leaf fall, when the grass is not yet matted. Do not make broadcast application of bait over growing crops when the bait may lodge on the plant. Do not apply to bare ground.

See back panel for additional Directions For Use

DIRECTIONS FOR USE
(Continued)

RANGELANDS AND REFORESTATION SEEDING AREAS

USE RESTRICTIONS: For control of meadow, prairie, and pine voles *(Microtus spp.)* and white-footed mice *(Peromyscus spp.)* during rangeland and reforestation seedings and plantings. Treatment at the rate of 6-10 pounds per acre should occur in the fall before the seed fall or seeding efforts. Treatment may be necessary in spring to protect emergent seedlings.

BAITING: For hand baiting place teaspoonful of bait in surface runways or in burrow entrances. If a trailbuilder is used, apply at the rate of one teaspoonful of bait at 4-5 foot intervals. For broadcast baiting, apply in 20 foot swaths evenly by hand or with a cyclone seeder. For aerial application, broadcast bait at the rate of 6-10 pounds per acre

NONCROP AREAS

USE RESTRICTIONS: For control of meadow, prairie, and pine voles *(Microtus spp.)* and white-footed mice *(Peromyscus spp.)* in non-crop areas such as right-of-ways, lawns, parks, nurseries, and golf courses when damage or heavy mouse infestations occur. Prebaiting with 3-5 pounds per acre of untreated wheat 2-3 days before applying toxic bait may provide more consistent toxic bait acceptance.

HAND BAITING: Place teaspoonful quantities of bait, either in surface runways or at mouth of holes leading to underground burrow systems. Bait at the rate of 3-5 pounds per acre in infested areas.

TRAILBUILDER: Apply teaspoonful of bait 4-5 foot intervals in the artificial runways around infested areas.

BROADCAST BAITING: Apply evenly by cyclone seeder or by hand at the rate of 3-5 pounds per acre.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Keep away from humans, domestic animals, and pets May be fatal or harmful if swallowed Avoid eye or skin contact Do not breathe dust Avoid contamination of feed or food stuffs Prevent the contact of bait with acids Wash hands thoroughly with soap and water after use Use rubber gloves if contact with skin may occur when mixing or placing baits Wash all utensils, spoons, or measuring devices thoroughly

ENVIRONMENTAL HAZARDS

This product is toxic to wildlife and fish Birds and other wildlife feeding in treated areas may be killed Use with care when applying in areas frequented by wildlife or adjacent to any body of water Keep out of lakes, ponds, or streams This product shall not be applied over bodies of water, in areas inhabited by livestock, or where a hazard exists to rare or endangered species Do not contaminate water by cleaning of equipment or disposal of wastes

ENDANGERED SPECIES CONSIDERATIONS

Whooping Crane *(Grus americana)*
Do not use this product 30 days prior to arrival and 30 days after the whooping crane leaves its known critical habitat.

Attwater's Greater Prairie Chicken *(Tympanuchus cupido attwateri)*
Do not use this product in critical habitat of the Attwater's greater prairie chicken in the following Texas counties: Aransas, Austin, Brazoria, Colorado, De Witt, Ft. Bend, Galveston, Goliad, Harris, Refugio, Victoria, Waller, and Wharton.

Yellow-Shouldered Blackbird *(Agelaius xanthomus) and* **Puerto Rican Plain Pigeon** *(Columba inornata wetmorei)*
Do not use in critical habitat except in tamper-proof bait boxes: within 6.3 miles of central Aquirre Lago Cicra, Ceiba, San German; 9.4 miles of La Esperanza; south of highway 2 from city at Mayaquez to the city of Ponce, and all of Mona Island. Puerto Rico.

Utah Prairie Dog (Cynomys parvidens)
Do not use this product in critical habitat of the Utah prairie dog. (Utah)

Salt Marsh Harvest Mouse *(Reithrodontomys raviventris)*
Do not use this product in critical habitat within 0.5 mile of salt marsh vegetation and/or brackish water wetlands which are located: 1) near or adjacent to San Pablo Bay and San Francisco Bay, or 2) in the Sacramento River below or adjacent to the confluence of the Sacramento River and the San Joaquin River. (California)

Morro Bay Kangaroo Rat *(Dipodomys heermanni morroensis)*
Do not use this product in critical habitat within 2.5 miles of Baywood Park which is located on Morro Bay. (California)

Aleutian Canada Goose *(Branta canadensis leucopareia)*
Do not use this product from October to March in the federally closed goose hunting areas in the State of California. See current duck and goose hunting game laws for current map

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

ZINC PHOSPHIDE ON STEAM-ROLLED OATS

FOR MOUSE CONTROL

For the control of meadow and pine voles, and white-footed mice in orchards and groves.

ACTIVE INGREDIENT:

Zinc Phosphide	2.0%
INACTIVE INGREDIENTS:	98.0%
TOTAL	100.0%

KEEP OUT OF REACH OF CHILDREN

CAUTION

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

Any person applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness, should be seen by a physician immediately.

If swallowed, drink 1-2 glasses of water and induce vomiting by touching the back of the throat with the finger. Avoid the use of all oils. Have person lie down and keep warm Do not induce vomiting or give anything by mouth to an unconscious person.

If on skin or eyes, flush with plenty of water.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
NATIONAL TECHNICAL SUPPORT STAFF/ADC
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-5

Net Weight lbs.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling

USE RESTRICTIONS: For control of meadow and pine voles *(Microtus spp.)* and white-footed mice *(Peromyscus spp.)* in orchards and groves. Apply bait after harvest while the orchard or grove is in a nonbearing phase. Do not apply on bare ground or growing crops. Wear rubber gloves when handling bait. Do not graze animals in treated areas.

HANDBAITING: Near the base of each infested tree, place teaspoonful quantities of bait at 2-4 locations, either on surface or at the mouth of holes leading to underground burrow systems. Cover bait artificially (e.g., mats, boards) or by pulling overhanging grass back into place Do not disturb the runway system. Bait at the rate of 2-3 pounds per acre of infested trees.

TRAILBUILDER: Drop teaspoonful quantity of bait at 4-5 foot intervals in the artificial trail made by the machine just inside the drip line on both sides of the trees. Apply at the rate of 2-3 pounds per acre.

BROADCAST BAITING: Under infested trees broadcast evenly by cyclone seeder or by hand. Concentrate in areas with the heaviest vegetation cover. Apply at the rate of 6-10 pounds per acre.

AERIAL APPLICATION: Broadcast bait at a rate of 6-10 pounds per acre.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Keep away from humans, domestic animals, and pets May be fatal or harmful if swallowed Avoid eye or skin contact Do not breathe dust Avoid contamination of feed or food stuffs Prevent the contact of bait with acids. Wash hands thoroughly with soap and water after use Use rubber gloves if contact with skin occur when mixing or placing bait Wash all utensils, spoons, or measuring devices thoroughly

ENVIRONMENTAL HAZARDS

This product is toxic to wildlife and fish. Birds and other wildlife feeding in treated areas may be killed. Use with care when applying in areas frequented by wildlife or adjacent to any body of water Keep out of lakes, ponds, or streams This product shall not be applied over bodies of water, in areas inhabited by livestock, or where a hazard exists to rare or endangered species. Do not contaminate water by cleaning of equipment or disposal of wastes

ENDANGERED SPECIES CONSIDERATIONS

Whooping Crane *(Grus americana)*
Do not use this product 30 days prior to arrival and 30 days after the whooping crane leaves its known critical habitat

Utah Prairie Dog *(Cynomys parvidens)*
Do not use this product in critical habitat of the Utah prairie dog (Utah)

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

ZINC PHOSPHIDE ON STEAM-ROLLED OATS

FOR PRAIRIE DOG CONTROL

For the control of black-tailed prairie dogs, white-tailed prairie dogs, and Gunnison's prairie dogs on rangelands in the following states: North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, New Mexico, Arizona, Colorado, Montana, Utah, and Wyoming.

ACTIVE INGREDIENT:	
Zinc Phosphide	2.0%
INACTIVE INGREDIENTS:	98.0%
TOTAL	100.0%

KEEP OUT OF REACH OF CHILDREN

CAUTION

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

Any person applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness, should be seen by a physician immediately.

If swallowed, drink 1-2 glasses of water and induce vomiting by touching the back of the throat with the finger Avoid the use of all oils Have person lie down and keep warm. Do not induce vomiting or give anything by mouth to an unconscious person.

If on skin or eyes, flush with plenty of water.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
NATIONAL TECHNICAL SUPPORT STAFF/ADC
Hyattsville, MD 20782
EPA Est. No 56228-ID-1
EPA Reg No. 56228-14

Net Weight lbs

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling

USE RESTRICTIONS: For control of black-tailed *(Cynomys ludovicianus)*, white-tailed (C leucurus), and Gunnison's prairie dogs *(C gunnisoni)*, on rangeland in Western United States (North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, New Mexico, Arizona, Colorado, Montana, Utah, and Wyoming) where non-target species (especially black-footed ferrets) will not be endangered

PREBAITING: Prebait with 4 grams (1 teaspoon) of untreated steam-rolled oats per mound, 1-2 days prior to baiting, to increase acceptance of treated baits by prairie dogs

BAITING: Apply bait only after all or most of prebait is eaten and only to areas where untreated bait was consumed. Establish observation period during prebaiting. Apply bait by hand as a six-inch bait spot on edge of each mound or in adjacent feeding areas Application rate should not exceed 4 grams (1 teaspoon) per bait spot. Treat during late summer or fall period (July-January) Do not apply more than 1 bait application during this period. Dispose of spilled or unwanted bait by burial.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Keep away from humans, domestic animals, and pets. May be fatal or harmful if swallowed. Avoid eye or skin contact. Do not breathe dust. Avoid contamination of feed or food stuffs. Prevent the contact of bait with acids. Wash hands thoroughly with soap and water after use. Use rubber gloves if contact with skin may occur when mixing or placing bait. Wash all utensils, spoons, or measuring devices thoroughly.

ENVIRONMENTAL HAZARDS

This product is toxic to wildlife and fish. Birds and other wildlife feeding in treated areas may be killed. Use with care when applying in areas frequented by wildlife or adjacent to any body of water. Keep out of lakes, ponds, or streams. This product shall not be applied over bodies of water, in areas inhabited by livestock, or where a hazard exists to rare or endangered species. Do not contaminate water by cleaning of equipment or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

Whooping Crane *(Grus americana)*
Do not use this product 30 days prior to arrival and 30 days after the whooping crane leaves its known critical habitat.

Salt Marsh Harvest Mouse *(Reithrodontomys raviventris)*
Do not use this product in critical habitat within 0.5 mile of salt marsh vegetation and/or brackish water wetlands which are located: 1) near or adjacent to San Pablo Bay and San Francisco Bay, or 2) in the Sacramento River below or adjacent to the confluence of the Sacramento River and the San Joaquin River (California)

Morro Bay Kangaroo Rat *(Dipodomys heermanni morroensis)*
Do not use this product in critical habitat within 2.5 miles of Baywood Park which is located on Morro Bay.(California)

Aleutian Canada Goose *(Branta canadensis leucopareia)*
Do not use this product from October to March in the federally closed goose hunting areas in the State of California. See current duck and goose hunting game laws for current map

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

ZINC PHOSPHIDE ON ROLLED OAT GROATS

FOR GROUND SQUIRREL CONTROL

For the control of California ground squirrels along noncrop rights-of-way in the following states: California, Nevada, and Oregon.

ACTIVE INGREDIENT:

Zinc Phosphide	2.0%
INACTIVE INGREDIENTS:	98.0%
TOTAL	100.0%

KEEP OUT OF REACH OF CHILDREN

CAUTION

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

Any person applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness, should be seen by a physician immediately.

If swallowed, drink 1-2 glasses of water and induce vomiting by touching the back of the throat with the finger. Avoid the use of all oils. Have person lie down and keep warm. Do not induce vomiting or give anything by mouth to an unconscious person.

If on skin or eyes, flush with plenty of water.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
NATIONAL TECHNICAL SUPPORT STAFF/ADC
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-18

Net Weight lbs.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS: For control of California ground squirrels *(Spermophilus beecheyi)* on noncrop rights-of-way adjacent to canal and ditch banks and other noncrop borders during late Spring and Summer. Zinc phosphide must not be applied on roads, near residential areas, over water or where plants are grown for food or feed. Before undertaking ground squirrel control with this product, consult local, State, and Federal game authorities to insure use is in accordance with regulations.

PREBAITING: Prebait with 6 pounds of untreated oat groats per acre along rights-of-way 2-3 days prior to applying toxic bait to increase bait acceptance by ground squirrels.

BAITING: Treat only once during treatment period and only after prebait is consumed. Broadcast bait in a 10-15 foot swath along right-of-way. Using hand or ground-driven bait dispensing devices not to exceed 6 pounds per acre. Bait will be applied only to the canal right-of-way between the base of the levee and adjacent properties. The canal and levee will not be treated. Dispose of bait and carcasses by burial within 3 days after treatment.

Part II

List of State and Local Need (FIFRA Section 24c), Emergency Exemptions (FIFRA Section 18), Experimental Use (FIFRA Section 5), and Investigational Drug (FDA) Registrations Held by U.S. Department of Agriculture Animal and Plant Health Inspection Service Animal Damage Control

State	Registration Number	Active Ingredient	Formulation (percent a.i.)*	Target Species
Alaska	56228-EUP-2[1]	Compound 1080	4 mg single dose bait	Arctic fox
American Samoa	90-DA-42[1] 91-DA-28	Brodifacoum	0.005% block	Rats
American Samoa	Sec 18 EE[2] (306-316)	Bromethalin	0.01% bait	Rats
Arizona.	AZ810016	Strychnine	1.6% paste	Rabbit
Arizona	AZ860006	DRC-1339	98% concentrate	Raven, crow
Arizona	AZ890007	DRC-1339	98% concentrate	Blackbird, starling, raven, crow, magpie, pigeon
California	CA890013	DRC-1339	98% concentrate	Raven
Georgia	GA900008	DRC-1339	98% concentrate	Pigeon
Hawaii	56228-EUP-5[1]	Diphacinone	2.5 ppm bait	Mongoose
Idaho	ID780011	DRC-1339	98% concentrate	Raven
Idaho	ID810047	Strychnine	1.6% paste	Jackrabbit
Idaho	ID860002	DRC-1339	98% concentrate	Raven, magpie
Idaho	ID870003	Strychnine	4.9% paste	Marmot
Idaho	56228-3EE[2]	Zinc phosphide	1.82% wheat	Voles
Illinois	IL890006	DRC-1339	98% concentrate	Starling
Indiana	IN840005	DRC-1339	98% concentrate	Blackbird, starling, crow, pigeon
Indiana	IN900003	DRC-1339	98% concentrate	Pigeon, crow, blackbirds
Kansas	KS850008	DRC-1339	98% concentrate	Pigeon, crow
Kentucky	KY880002	DRC-1339	98% concentrate	Pigeon, crow
Kentucky	KY890003	DRC-1339	98% concentrate	Pigeon, crow, starling, blackbirds
Louisiana	LA880012	DRC-1339	98% concentrate	Blackbirds, starling
Michigan	MI910001	DRC-1339	98% concentrate	Pigeon
Michigan	MI920002	DRC-1339	98% concentrate	Starling

(Continued)

State	Registration Number	Active Ingredient	Formulation (percent a.i.)*	Target Species
Montana	MT860004	DRC-1339	98% concentrate	Raven, magpie
North Dakota	ND820001	Strychnine	8 mg/egg	Franklin ground squirrel
North Dakota	ND880001	Sodium nitrate/charcoal	Gas cartridge	Red fox
North Dakota	ND900001	DRC-1339	98% concentrate	Pigeon, crow, blackbirds
New Mexico	NM810003	DRC-1339	98% concentrate	Pigeon
New Mexico	NM810014	Zinc phosphide	2.0% oats	Prairie dog
New Mexico	NM820019	Strychnine	1.6% paste	Rabbit
New Mexico	NM880002	DRC-1339	98% concentrate	Raven, crow
Nevada	NV860003	DRC-1339	98% concentrate	Raven
Ohio	OH850001	Zinc phosphide	2.0% wheat	Mouse, vole
Oklahoma	OK880001	Zinc phosphide	2.0% oats	Prairie dog
Oregon	OR780014	DRC-1339	98% concentrate	Raven
Oregon	OR850002	DRC-1339	98% concentrate	Raven
Tennessee	TN890005	DRC-1339	98% concentrate	Pigeon, crow, blackbirds
Texas	TX890001	DRC-1339	98% concentrate	Pigeon, starling, blackbirds
Texas	TX900002	DRC-1339	98% concentrate	Raven
Utah	UT860002	Strychnine	0.6% wheat	Pigeon
Utah	UT870001	DRC-1339	98% concentrate	Raven
Utah	UT890002	DRC-1339	98% concentrate	Pigeon
Vermont	VT90-1[1]	Cholecalciferol	0.075% seed bait	Squirrel, chipmunk, mice
Vermont	VT90-5[1]	Zinc phosphide	2% bait	Squirrel, chipmunk, mice
Virginia	VA910010	DRC-1339	98% concentrate	Pigeon, crows, starling, blackbirds
Washington	WA780005	Zinc phosphide	0.75% bait	Rabbit
Washington	WA790002	DRC-1339	98% concentrate	Blackbird, starling
Washington	WA860011	DRC-1339	98% concentrate	Raven
Washington	State EUP based on ID870003[1]	Strychnine	4.9% paste	Marmot
Washington	State EUP[1]	Mineral Oil	99% concentrate	Ring-billed gull
West Virginia	WV910002	DRC-1339	98% concentrate	Pigeon, starling, blackbirds
All States	INAD 6602[3]	Alpha chloralose	99.5% concentrate	Geese, duck, coot, house sparrow, pigeon, gulls

* a.i. = active ingredient

[1] Experimental use permits.

[2] Emergency exemptions.

[3] Investigational New Animal Drug approved by U.S. Food and Drug Administration (FDA).

Part III

List of Commercially Registered Products Used, Supervised, or Distributed by U.S. Department of Agriculture Animal and Plant Health Inspection Service Animal Damage Control

EPA Registration Number	Product Name	Formulation (percent a.i.)*	Target Species	Registrant
Aluminum phosphide				
40285-1	Phostoxin	55% tablet	Commensal and burrowing rodents, moles	Degesch America, Weyers Cave, VA
2548-69	Detia Rotox AT	57% tablet	Woodchuck, marmot, prairie dog, rats, mice, ground squirrel, mole, vole, gopher, chipmunk	McShares Inc. Salina, KS
5857-1	Fumitoxin	55% tablet	Woodchuck, marmot, prairie dog, rats, mice, ground squirrel, mole, vole, gopher, chipmunk	Pestcon Alhambra, CA
43743-1	Gastoxin	57% tablet	Woodchuck, marmot, prairie dog, rats, mice, ground squirrel, mole, vole, gopher, chipmunk	Bernardo Chemicals Memphis, TN
4-Aminopyridine				
11649-1	Avitrol	0.5% wheat	Blackbird, starling, house sparrow	Avitrol Corp., Tulsa, OK
11649-4	Avitrol	0.5% mixed grains	Blackbird, starling, house sparrow	Avitrol Corp., Tulsa, OK
11649-5	Avitrol Corn Chops	1% bait	Blackbirds, starling	Avitrol Corp. Tulsa, OK
11649-6	Avitrol Corn Chops	0.5% bait	Blackbirds, starling	Avitrol Corp. Tulsa, OK
11649-7	Avitrol	0.5% whole com	Pigeon	Avitrol Corp., Tulsa, OK
11649-8	Avitrol Whole Corn	1% bait	Crows	Avitrol Corp. Tulsa, OK
11649-10	Avitrol	25% concentrate	Gulls	Avitrol Corp. Tulsa, OK
OK900002	Avitrol Powder Mix	50% powder	Crows	Avitrol Corp. Tulsa, OK

(Continued)

EPA Registration Number	Product Name	Formulation (percent a.i.)*	Target Species	Registrant
Ammonium salts				
400-383	Hinder	15% liquid	Deer, rabbits	Leffingwell Brea, CA
Bone tar oil				
4704-3	Magic Circle deer repellent	93.75% concentrate	Deer	State College Laboratories Reading, PA
Brodifacoum				
10182-38	Talon-G	0.005% pellets	Norway rat, house mouse	ICI Americas, Inc., Wilmington, DE
10182-39	Talon-G	0.005% pellets	Norway rat	ICI Americas, Inc., Wilmington, DE
10182-40	Talon-G	0.005% mini-pellets	Rats, mice	ICI Americas, Inc. Wilmington, DE
10182-41	Talon-G	0.005% mini-pellets	Rat, mouse	ICI Americas, Inc., Wilmington, DE
10182-48	Weather Blok	0.005% bait block	Norway and roof rats, mouse	ICI Americas, Inc., Wilmington, DE
Bromethalin				
602-316	Purina Assault	0.01% bait place pack	Norway and roof rats	Purina Mills, Inc., St. Louis, MO
432-747	Vengeance	0.01% bait	Norway and roof rats, mouse	Roussel Bio Corp., Englewood Cliffs, NJ
Chlorophacinone				
7173-80	RoZol Rat and Mouse Bait	0.005% bait	Rats, mice	Chempar New York, NY
Cholecalciferol				
12455-39	Quintox Rat and Mouse Bait	0.075% bait	Rats, mice	Bell Laboratories Madison, WI
Compound 1080				
46779-1	Livestock Protection Collar	1% solution (in collars)	Coyote	Ranchers Supply Alpine, TX
Compound DRC-1339				
602-136	Starlicide Complete	0.1% bait	Starling, blackbird	Ralston Purina, St. Louis, MO

(Continued)

Q Appendix

EPA Registration Number	Product Name	Formulation (percent a.i.)*	Target Species	Registrant
Dihydrochloride				
11649-16	Ornitrol chemosterilant	0.1% corn	Pigeon	Avitrol Corp. Tulsa, OK
Diphacinone				
HI910004	Diphacinone concentrate	0.1% powder	Mongoose	Bell Laboratories Madison, WI
8612-75	Tarla-Diphas Green	0.005% bait	Rat, mouse	B&G Company, Dallas, TX
8612-77	Tarla-Diphas Blue	0.005% bait	Rat, mouse	B&G Company, Dallas, TX
56-18	Eaton's All Weather Bait Blocks	0.0025% bait	Norway and roof rats	J.T. Eaton & Co., Twinsburg, OH
56-20	Eaton's Sewer Rat Bait Blocks	0.0025% bait	Rat	J.T. Eaton & Co., Twinsburg, OH
56-54	Eaton's All Weather Bait Bitz	0.005% bait	Commensal rats and mice	J.T. Eaton & Co., Twinsburg, OH
876-198-AA	Ramik Meal	0.005% bait	Commensal rats and mice	Velsicol Chemical Co., Chicago, IL
Drugs (Euthanizing/ Immobilizing)[1]				
NDC-0061-0473-05	Beuthanasia-D	Injectible solution	Mammals	Schering-Plough Kenilworth, NJ
NADA 45-290	Ketaset	Injectible solution	Mammals	Aveco Co., Inc. Fort Dodge, IA
NADA 139-236	Xylazine (Rompun, Anased)	Injectible solution	Mammals	Lloyd Laboratories Shenandoah, IA
Fenthion				
7579-2	Rid-a-Bird	11% liquid	Pigeon, house sparrow, starling	Rid-a-Bird Muscatine, IA
HI830005	BCF #1	9% liquid	Pigeon, house sparrow, starling	Bird Management Research Clinton, IN
Glyphosate				
524-343	Rodeo herbicide	54% concentrate	Blackbird habitat (marsh vegetation)	Monsanto St. Louis, MO
Methiocarb				
3125-309	Mesurol bird repellent	50% wettable powder	Birds	Mobay Kansas City, MO
Pivalyn				
3240-3	Pivalyn	1.5% concentrate	Rat, mouse	Motomco, Inc., Clark, NJ

(Continued)

EPA Registration Number	Product Name	Formulation (percent a.i.)*	Target Species	Registrant
Polybutene				
8254-1	Eaton's 4-the-birds	80% gel	Pigeon, house sparrow, starling, gulls, crow, blackbirds, raven	J.T. Eaton & Co. Twinsburg, OH
Putrescent egg				
1021-1380	Big Game Repellent	5% egg solids	Deer	McLaughlin Gormley King Minneapolis, MN
Strychnine				
8612-30	Sparrow-Cracks	0.6% grain	House sparrow	B&G Company, Dallas, TX
9561-2	Kelley's One-Sixteen Bait	0.35% grain	Birds	Kelley's Rodent Control Service Edinburg, TX
Warfarin				
12455-15	Final Rat & Mouse Bait	0.025% bait	Rats, mice	Bell Laboratories Madison, WI
12455-22	Liqua-Tox	0.54% liquid concentrate	Rat, mouse	Bell Laboratories, Madison, WI
Zinc phosphide				
12455-17	ZP Rodent Bait AG	2% bait	Ground squirrel, prairie dog, rat, meadow and pine mice, vole, gopher	Bell Laboratories, Madison, WI
12455-18	ZP Rodent Bait	2% pellets	Rat, mouse	Bell Laboratories, Madison, WI
12455-30	Gopha-Rid	2% bait	Pocket gopher	Bell Laboratories, Madison, WI
2393-185	Zinc phosphide bait	2% bait	Rats, mice, voles, ground squirrels, prairie dogs, gophers, kangaroo rats	HACO Madison, WI
2393-521	Zinc phosphide pellets	2% bait	Rats, mice, voles, ground squirrels, prairie dogs, gophers, kangaroo rats	HACO Madison, WI
393-185-41937	D&H Formula Rodent Rid-R	2% bait	Voles, mice, gophers	D&H Chemical Co. Pendleton, OR
13808-6	ZP Prairie dog bait	2% steam rolled oats	Prairie dogs	SD Dept Agriculture Pierre, SD

* a.i. = active ingredient

[1] Products registered by the Food & Drug Administration (FDA).